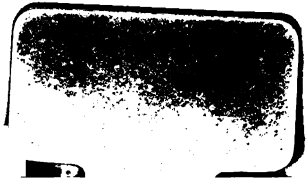
HINTS ON AGRICULTURE;



HINTS ON AGRICULTURE;

RELATIVE TO

Profitable Draining and Manuring;

ALSO

THE COMPARATIVE MERITS

OF THE

PURE BREEDS OF CATTLE AND SHEEP.

BY CECIL,

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&c. &c.

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PREFACE.

VARRO has observed with perfect truth, "Our experiments should be directed by reason, not by chance. We should obtain all that is obtainable by rational enquiry into Nature and her laws." This sentence cannot be too strongly impressed on the memory of agriculturists.

That diversities of opinion should prevail concerning the most efficient methods of draining land, cannot create any surprise when the varieties of soils are taken into account. Not only does the surface of the earth present many varieties, but the substrata through which water finds its passage, often in tortuous courses hidden from inspection, serve to perplex the most experienced judges.

The extensive use of artificial manures has introduced a new era in farming. It has been

productive in many instances of very beneficial results; but the fact must not be overlooked, that a super-abundance applied indiscreetly is injurious.

The superiority of the pure breeds of cattle and sheep is very generally admitted; so much so, indeed, that there are but few amongst the most unenlightened breeders, who do not appreciate their value for admixture with the common or local breeds; yet there are a vast number who do not distinguish their respective merits, or make selections of those kinds which are best adapted to the situations and circumstances connected with their farms.

To illustrate these subjects, this work has been written, with a hope that if it may not materially enlighten the highly scientific and experienced agriculturists, that there are many noviciates who may derive profit from the observations it contains.

HINTS ON AGRICULTURE.

DRAINING.

The important operation of draining land is by no means a modern invention; and although many years have elapsed since it was first introduced, during which period the march of agricultural improvement has made considerable progress, the physiology connected with draining is not thoroughly reduced to practice. The physician, when called upon to prescribe for a sick patient, first endeavours to ascertain the cause of indisposition, and then presents remedies calculated to remove the cause; so it must be in many instances with respect to draining; the source from whence the evil proceeds must be discovered, and this it is at times difficult to accomplish. Effective draining is of such vital importance to successful farming, that every item calculated to promote the object, demands the most scrutinizing investigation.

Lord Stanley, when in the chair at a meeting of the North Lancashire Agricultural Society, held at Preston, in August, 1856, in an able speech on the subject said, "I have spoken of draining as it affects this county, and I could extend what I have said to all England; and I venture confidently to affirm, that what has been done throughout the country in the way of draining, is as yet a mere trifle to what wants doing. I have seen various calculations on the subject. They do not precisely agree—estimates seldom do—but they nearly all agree in this, that there is room in the item of draining alone, for the profitable investment within the United Kingdom of £100,000,000 sterling. Now that seems a large sum, but if we recollect that statisticians have computed the yearly savings of our people, the yearly addition to the national capital, at £50,000,000; and if you recollect how within the last twenty years, a sum of nearly £300,000,000 has been invested in railways; that investment leaving on the whole, the country, not poorer, but richer than what it found it; if you recollect these two facts, I think neither you nor I need trouble ourselves much with asking where the money is to come from."

Assuming the average calculation of the cost of draining to be £5 per acre in round numbers, there

is in conformity with Lord Stanley's estimate 20,000,000 acres of land requiring to be drained, and this estimate is nearly similar to that of other authorities; but providing only one third of this is accomplished, to do that will involve the outlay of £33,333,333, and it behoves every individual, especially those who are connected with agriculture, to consider how it can be expended with the best prospect of profitable returns.

Estimating the increase of produce of wheat from 6,666,666 acres of land, one third of the quantity already referred to, as requiring to be drained, by an effective performance of that process, and subsequent good cultivation, land yielding not more than twenty bushels of wheat to the acre, would grow thirty, or an increase of ten bushels per acre. Under the four-course system it would therefore afford an addition of 2,083,333 quarters annually. It is not wheat only, but other cereals, grasses, and roots, that would be produced in greater abundance. This estimate may be considerably augmented, inasmuch as this, the calculation refers to an estimate that there is in the United Kingdom an extent of land amounting to 20,000,000 acres which requires draining, but whether that includes waste land or not, I am not certain. It is, however, estimated that there are 14,700,000 acres of waste land, a portion of which

remains in that state from want of draining. Providing only 4,000,000 acres of that were to be enclosed, drained, and cultivated, it might be made to produce annually of wheat, at the rate of thirty bushels to the acre, an increase of 3,750,000 quarters, which, with the above, would yield a total of 5,833,333 quarters.

Every description of land has, to a certain extent, a natural course or system of drainage; that is, there are channels through which the water can pass; but they possess different degrees or facilities of percolation, and they assume directions in many instances highly prejudicial to the growth of vegetation on particular spots. They may be termed natural defects, and it is to remedy these imperfections that the art of draining is advantageously introduced.

The object to be gained by draining, in connection with agriculture, is to afford an escape for the water with sufficient facility, that it may not have the effect of chilling the land, and thereby retarding the progress of vegetation. Likewise, to afford the manures which are applied an opportunity to develope their powers; a higher temperature is gained by draining; this is a phenomenon which theory suggests, and experience confirms. The process of evaporation which cools the atmosphere is diminished by the water when it subsides into, and passes off through the drains. This will of course be

greater in its proportions on porous soils than retentive clays.

As a sanitary agent, draining is of great importance, most especially in fenny districts, and in situations where peaty soils exist, from which the amount of evaporation is very extensive—baneful alike to the health of man and beast. In such localities as those just named, the atmosphere is more unhealthy than on clay soils, the retentive powers of which being greater, evaporation is less active.

Stagnant water, especially that which lies below the surface of the earth, is prejudicial to the growth of those plants which we require to cultivate. The evaporation therefrom is so extensive, ascending in the form of vapour, as to occasion agues, rheumatism, and other disorders in the human race.

The observant traveller, as he passes through the country, his journey accelerated by the mighty powers of fire and water, can scarcely fail to contemplate the numbers of acres which stand in need of human ingenuity to render them fertile by draining. However innocent the traveller may be of the anxieties and toils, the studies and manipulations, of the farmer, he will see during the wet, wintry seasons of the year, pools of water on the surface of the earth; at other times, when the arid winds of March commence, certain portions of arable land will appear dry, and

others moist, distinguishable by the appearance of dark brown patches,—certain indications for the necessity for draining. On grass lands, the poaching of cattle, together with the production of rushes, and other aquatic grasses, present similar indications. These appearances will afford much information to the practitioner if he studiously observes them, as to the most elligible position and arrangement of the drains. It must be admitted that a large extent of land has been drained within the last ten or fifteen years, much very effectively, and some quite the reverse. Many of the poor soils, which are impoverishingly dear at ten shillings per acre, by draining and judicious cultivation, may be rendered cheap at more than double that amount.

The importance of draining being admitted, the question arises, how can it be most satisfactorily accomplished? It is not by draining a field partially, or placing the drains in such a position that they cannot draw off the water with sufficient rapidity to free the land from the ill effects of a superabundance, that can come under the denomination of thorough draining, as it is insisted upon by the enlightened agriculturist of the present day, so that it may be the ground-work of future improvement. Much diversity of opinion has arisen on various subjects connected with draining, and it may

be well to investigate the origin of those anomalies. In the first place, systems have been adopted by persons who have been employed to drain estates by contracts, which have in some instances been thoroughly successful, in others failures. Taking the successful issues in evidence of the soundness of their practice, those persons have carried out the same plans on lands totally different, and therefore requiring different treatment; but having adopted them, and without the candour to confess the errors of their ways, pertinaciously defend them, in defiance of reason and experience.

There are several instances of draining having been performed in such an imperfect manner, which have come under my own observation, that I could not but feel sentiments of regret at the thought of so much money having been expended without a prospect of remuneration.

Unfortunately for the agricultural community, there is a great want of uniformity of expression to convey definite meanings. The arguments of many persons who are desirous to convey their opinions, to the public, and who from their known talent are capable of affording much valuable information, in a great measure fail, because they express themselves in terms not universally comprehensive. They speak of sands, loams, and clays, without bearing in remembrance that a person living in a sandy district will

call a loam *clay*, but which a farmer cultivating a heavy clay would designate as *sand*. Some acknowledged rule is wanting to compare the absorbent and retentive properties of soils. Much ambiguity arises also from modes of explanation, which apply to individual cases only. The success or failure of draining, as respects the depth and the arrangement or course of the drains, depends in many cases upon the quality or nature both of the surface soil and the substrata. The quality and undulations or form of the surface are readily distinguished, but not so the substrata, which can only be determined by careful examination—that is, by making use of the spade; and in many instances the variations will be so considerable that not until the earth is removed for the purpose of forming the drains will it be discovered what course the water takes, and this is not unfrequently neglected. Diversity of opinions are held as to the effect of water; some urge it is only that which flows under the surface, spring water as it is termed, that is injurious, but that which falls on the surface is beneficial, and, therefore, ought not to be drawn off. A person living in a district, and confining his observations exclusively to that district where the injury proceeds solely from under-currents of water in marshy, peaty lands, learns from experience that to provide drains for the springs is all that is re-

quired, and by extending the operations beyond that point is waste of capital. Strong clay soils will nevertheless derive benefit from the surface-water being drawn off more quickly. There are many instances where tracts of land of that nature are not in the least degree affected by water flowing beneath, which are very materially improved by draining.

If the subsoils throughout the kingdom, or even in districts, were uniform, the course which water takes in its passage through the earth would also be uniform, and theory would be very readily applied to practice. But that is not the case; and there is also a great variety of surface-soil, the characteristics of which are well known as appertaining to districts, and yet there are exceptions. There is a great diversity of substrata possessing many degrees of facility for the percolation of water; the porous sand and peat, the loamy soil, the almost impervious clay, and rocks of divers constituents forming basins or reservoirs in which water becomes stagnant, and remains for indefinite periods, not only to the prejudice of vegetation but also to the contamination of the atmosphere. With these complexities to contend against, it is not astonishing that the most scientific and practical should frequently be puzzled.

It was the impression at one time of sanguine theorists that the science of geology would direct at

once the practice of draining. We were instructed, that it was only necessary to procure a geological map and ascertain at once the nature of the subsoil. How this science can be worked into a practical form as an invariable assistant in draining, it is impossible to speculate. The superficial deposits vary extensively, and in many instances it is only the deposits with which agriculturists have to deal—in other words, they are deeper than drains are required, or the deepest cultivation can possibly demand. The beds of rock, clay, gravel, and sand, which are recognized as local distinctions in various parts of England, together with certain indications which may be adopted as a principle, can be understood by researches in geological studies ; but they appertain to districts, not to individual fields—indeed parts of fields, the soils and sub-soils of which are found to differ from each other, and thus may be seen the impracticability of taking a geological map as the basis of draining operations. It is the depth and component elements of the subsoil in the majority of cases, and on every spot which requires to be known, and without that information no works of draining can be effectually accomplished. If the formation of the earth were uniform throughout districts, instead of being diversified with numerous stratifications, geology would be an unerring guide.

Geology is good in theory, and may be applied to a certain extent as an auxiliary to the plans of the drainer; but as to forming rules in all cases, by the most accurate researches into that science, it is impossible. No man can go into a field and determine by a superficial survey, with a view to efficiency and economy, either the most desirable depths for the drains, the most advantageous courses for them to take, or the proper intervals between them. These facts can only be determined by making holes in different parts to find the nature of the subsoil, which frequently varies within a few yards, and by that means ascertaining not only its qualities of percolation, but the subterranean course of the water in the event of its flowing irregularly; and then having proved the depth at which the water takes its course, or lodges in stagnant under-ground pools, as the case may be, decide upon the depth and course of the drains according to those circumstances. The intelligent and observant farmer, who has watched the condition of his land with an anxious eye for many years, and at different seasons, has an evident advantage over the professional contractor frequently employed to undertake the work and direct the operations. A casual inspection cannot in all cases enable such a person to do justice to his employers or credit to himself. Unfortunately thousands of acres have been

drained under these circumstances, and many more thousands of pounds have been ingloriously consigned to the bowels of the earth without a prospect of an equivalent return.

Where the soil is known to possess homogeneous properties, the science of geology may, to a limited extent, be enlisted in the science of draining with some effect; and if every spongy and boggy spot of earth was subservient to similar actions, science would direct the remedy with as much unerring certainty as the surgeon who takes up the femoral artery when performing an amputation of the thigh—but there is this distinction, the surgeon knows the precise course of the blood vessels through the human frame, and the position of every artery; but the course of water below the surface of the earth flows through hidden channels, and to discover them it frequently perplexes the most skilful.

The efficacy of drains cannot be admitted unless they take away from the soil with sufficient promptitude the superabundance of water which lodges within reach of the roots of whatever plants are cultivated. Hence the great difficulty of draining strong clays.

Two very important considerations present themselves when the process of draining is determined upon—efficacy and economy—bearing in mind that

the last-named desideratum cannot be fulfilled unless the former object is thoroughly attained. Many very great improvements have been introduced in farming operations during the last few years, especially in machinery; to the mechanical ingenuity of England farmers are deeply indebted, but there are many wild romantic speculations and theories afloat which have been promulgated with enthusiastic zeal, and it behoves every individual connected with agricultural pursuits to distinguish between visionary phantoms and sound principles. Discrimination and consistency form two very important items in the successful cultivation of the earth; and whatever sensations the ultra-fast-men of the present day may create, their practices will result in failures, unless they are founded upon reason, and are in conformity with the immutable laws of nature.

Draining is an expensive process, and it is not at all times convenient to landowners to provide the necessary funds; tenants, if they are in a position to supply the means, cannot prudently incur the outlay unless they are secured by lease or some other satisfactory indemnity. To meet this difficulty Government has come forward to make advances, and four companies have been formed for a similar purpose. The loans from Government are limited to £4,000,000, a great portion of which has been expended. There

is yet a very large sum required for the purpose. Carrying on my calculations upon the same scale as that with which I commenced, that of draining one-third of the quantity of land which statistical estimates have described as standing in need of this process, the amount of money required, as previously mentioned, will be £33,333,333, a great portion of which must, in all probability, be obtained in the way of loan. It appears to me somewhat chimerical to estimate the private resources of landed proprietors, but assuming they are provided with one-third, there still remains a large sum to be borrowed. However, when it is remembered that such loans are secured according to act of Parliament, by first charges on the freeholds, better securities cannot be desired, and there is little doubt of the money being forthcoming when wanted.

It is not my object in these remarks to discourage the utmost development of the first preliminary to good and successful farming, on the other hand, to promote it upon sound principles, upon a basis upon which success may be reasonably anticipated. The vital importance of successful draining cannot be questioned, and every item in connection with the performance of the work, however trifling, cannot be too scrupulously investigated. The subject has engrossed the attention of the public mind, and very

naturally so, considering that several attempts at draining land have been great failures, and the large sums of money which may be called in requisition with similar results. The satisfactory performance of the work is a subject of very serious importance, under whatever circumstances it may be accomplished. If a land-owner has at his command the money requisite for the purpose, and expends it without producing the necessary intention, he, and probably his successor, will suffer from the inadvertency. Providing a per centage be charged upon the outlay as an additional rent, and the land is not improved in proportion to the outlay, both landlord and tenant suffer, and on a future day, in the event of imperfect drainage, the loss will probably fall upon the land-owner. A tenant, for whom land has been drained, may die or resign his farm, and a new occupant may not be willing to pay a per centage upon an expenditure which has proved abortive. In the event of borrowing the money from the public funds or one of the companies already mentioned, upon terms of repayment, varying from twenty-two years, to perpetuity, as may be agreed upon, and a system of draining be adopted which proves ineffective, a rent-charge is established which may fall unwelcomely upon a successor. But on the other hand, if the work is performed satisfactorily the land-owner im-

proves the value of his estates, confers a benefit on his tenants, and the public are gainers by the additional quantity of food raised for their consumption.

It is not intended in these remarks to offer discursive opinions relative to landlord and tenant, as to which ought to bear the expenses of draining. That is a consideration which must rest between them, dependent upon the terms of occupation. In cases of annual tenancy it can scarcely be prudent for a tenant to incur such an outlay, and the custom sometimes adopted by the landlord charging a per centage on the capital expended, is certainly a good investment for his superabundant funds. In such cases it seems scarcely equitable to charge the interest, or, in plain terms, to raise the rent until the land drained affords evidence of improvement. This, however, depends upon whether the work is performed under the direction of the landlord or the tenant. Being what is commonly denominated a permanent improvement, draining appears to come most essentially within the province of the landlord, but the term is rather an expansive one. No labour which comes within the sphere of human operations is permanent, and the practice of draining land has not yet attained those degrees of perfection that the term in its ordinary acceptation can be applied. It bears distinction from buildings, which, if constructed with good ma-

terials, will certainly last for an indefinite number of years, accidents from fire excepted, but draining cannot be performed with equivalent prospects of endurance.

The advocates of a universal system of draining, may adduce, in opposition to others who maintain that no such practice can be relied on, and that experiments must be made in many instances to ascertain the proper arrangement and depth of drains, that they, the advocates of the universal system, have gained the experience their opponents lack; that they have, in fact, attained such perfection in their calling that, by a superficial survey of the land, or even without that labour, by the aid of a geological map, they can lay out their plans at once. Whoever may have land which requires draining, and is content to abandon his capital to the tender mercies of such theorists, must be credulous indeed, and careless of his resources. Taken as a body, however, agriculturists are careful and studious in the matter of expenditure.

The question, as it relates to the depth of drains, may be divided into three classes, each of which has its advocates. Some insist upon deep drains, that is, at a minimum depth of four feet; others, that shallow draining is equally beneficial, and much less costly. The partisans of the other class declare that

there is no rule to be adopted, but that the depth of the drains to be effective must be regulated by circumstances. I have no hesitation in enlisting myself under the banners of the latter. The partisans of the first two systems are most probably right under certain circumstances, but it is impossible to determine upon any depth that will be advantageous in all soils and situations. The natural formation of every field, the quality of the surface and subsoil should be carefully inspected, and the works arranged to meet the exigences which present themselves. The advocates of deep draining argue differently. With the views of the latter, the Inclosure Commissioners have, it is understood, given their concurrence with reference to loans on entailed estates, when the inheritance is to be charged with them. Unfortunately for myself, I am not, that I am aware of, heir to any estate subservient to this regulation, or I might under certain circumstances—the draining of retentive clay soils, for example—be induced to protest strongly against it; and on many other occasions, considering the additional expenditure involved, be equally opposed to participate in the re-imbursement of the outlay. But it is, however, apparent that some rule must be adopted in such cases; whether this will prove to be a satisfactory one, time and experience will develop. It will surely deter many from employing borrowed

capital on those terms for the purpose. Deep draining, or that which is performed at a minimum depth of four feet, appears to come under the denomination of permanent; but where less than that depth, it seems to be designated temporary. Upon what principles these terms are justified I am rather at a loss to define. If the permanency were governed in proportion with the depth, the efficiency being equal, there could be no question as to which would prove the most desirable. It was expected, fifty years ago, that the introduction of the horse-shoe or semicircular tiles would render drains constructed with them capable of lasting for indefinite periods. It would be interesting to know how many drains so formed at that period are effective at the present moment? I do not think I am in error when I state there are none. Taking into consideration the question between that which may be termed temporary and that which is designated permanent draining, with reference to the most judicious outlay of money, if the former can be performed at the cost of £1 10s. per acre, and it is followed by satisfactory results during a term of only seven years, and by expending £5 per acre with some chance of a failure, but with a reasonable hope that it will endure twenty-eight years, the issue will be in favour of the former system. By way of illustration, take an extent of fifty acres:

expend in draining it the first-named sum, the amount of capital required will be £75, interest thereon £3 15s. per annum; this for seven years, considering the capital to be sunk at the end of that period, will be £26 15s., which, added to capital, amounts to £101 15s.—or about 5s. 11d. per acre per annum. In the event of the draining enduring fourteen years, the annual cost would be reduced to only 3s. 8d. As to drains, however the work may be performed, lasting for a very great length of time, I am more than sceptical.

To expend £5 per acre involves an immediate outlay of £250, the common rate of interest upon which for twenty-eight years will be £350, and that sum added to capital gives £600, about 8s. 5¾d. per acre per annum. Taking into consideration the contingency, that after the last-named expense has been incurred, it may not have the beneficial and permanent effects contemplated, in which case the capital lies buried in the soil, the interest upon which alone amounts to 5s. per acre annually, very nearly equivalent to the sum required for executing the work upon an economical system, capital included, on a calculation of septennial permanency. In this estimate I have not taken into account the balance of capital saved, amounting to £175, sufficient, according to the lower scale of charges, to drain upwards of one

hundred and sixteen additional acres of land, or being reserved for future operations, the interest would be a consideration. The estimate of an average sum of £1 10s. is deduced from Lord Berners' statement that some of his Lordship's land at Keythorpe in Leicestershire has been effectively drained at a cost of from £1 to £2 per acre.

Mr. R. Baker, of Writtle, likewise, in a letter which was published in the "Farmers' Magazine" for March, 1856, describes a plan adopted by Mr. King Viall, of Stoke, near Clare, on the borders of Essex and Suffolk, the cost of which does not exceed thirty shillings per acre, and the drains are said to last good for sixteen years. The drains are filled with bushes;—but for full particulars the reader is referred to the periodical in which the letter appeared.

The power of evaporation should likewise be considered with regard to the depth of drains. When water has passed through the earth to a certain depth, evaporation is diminished; but the depth will be dependent upon the quality of the soil and atmospheric influences. Now as that evaporation has the effect of chilling the earth, and is pernicious to the growth of vegetation at cold seasons, it is evident that the perfection of draining must be in conformity with this process of nature. It has already been mentioned that evaporation is less active in clay soils

than those of a more porous character; hence it follows that so far as this property is affected in those soils, deep drains are not conducive to this purpose. As a general principle, except in soils of a very porous nature, the evaporating point may be considered from eighteen inches to two feet below the surface of the soil. The prevention of excessive evaporation is one of the principal objects gained by draining.

Evaporation is highest during the months of June, July, and August; and it is calculated that during those months the whole of the rain that falls is disposed of by evaporation. It diminishes in August, and is at its minimum in December and January. During five months of the year, that is from May to September inclusive, about 90 per cent. of rain evaporates, and through the remaining seven months 75 per cent. percolates, and only 25 per cent. is the equivalent of evaporation. One inch of rain-fall is estimated at one hundred tons of water per acre, and that quantity it is found must be deposited to wet the earth to the depth of three or four inches when distributed by carts or similar artificial means. A ton of water contains two hundred and twenty-four gallons; therefore where the rain-fall amounts to thirty inches in the course of the year it will be found that 672,000 gallons of water are distributed.

It has been suggested that the amount of rain-fall connected with the district should be taken into calculation in deciding upon the width between the drains. This appears to be a theory not unaccompanied with uncertainty. It is based upon the good intention of economy by not inserting a greater number of drains than are absolutely required. But the chief object of draining is to free the land from water when there is a superabundance. Acknowledging the value of the principle at what it is worth, and taking the average of rain-fall as a criterion, what would have been the results on land drained according to this proposition during the wet winter of 1852-53? But more than this, as it has already been observed, many fields, and even parts of fields, are much more obnoxious to wet than others in the surrounding district, in consequence of water which finds its way under the surface to particular spots. In those cases the calculation could not be acted upon successfully. On land affected merely by the rain which descends upon it, strong clays for example, which require draining in consequence of the retentive nature of the soil—in a word, where the quality is nearly equal, the system may be advantageously worked, taking the maximum amount of rain-fall rather than the average. Rain-gauges, however, are not without their use, and the informa-

tion afforded by their results may be brought into good effect in many situations.

Perfect drainage may be said to combine two objects, to carry off the surface water, in other words, the rain which descends from the atmosphere upon the land, and also the deep water, as it is sometimes named, by others termed the spring-water. Success in the former case will depend upon the depth of the drains, which must be regulated by the percolating quality or condition of the soil. If it be of a peaty and porous nature, drains three feet six or four feet will generally be found most effective. But not so with clay soils, which will scarcely permit the water to percolate. On such soils it is necessary to impress the reader with the absolute necessity of having the operation performed in such a manner that the water shall be drawn off quickly, and under any circumstances, as quickly as the nature of the land will possibly permit, without which the works cannot be passed as effectively completed.

An advocate for an universal system of drains four feet deep may show the casuist the openings of the drains, and declare, because there is water passing through them, that the work has been properly performed. But the mere fact of water being discharged is no evidence that it is drawn off with sufficient celerity to render the surface satisfactorily dry after

rain-fall. Unless the land on the surface and below the full depth of cultivation is found to be properly freed from the chilling effects of an excess of moisture, it is not thoroughly drained. This will be determined by the appearance and state of the land during wet periods, and at the spring of the year, and, more unequivocally still, by the state of the crops.

Nature in all her operations has provided well for most contingencies, and as clay soils are not gifted with the property of free percolation, as a compensation they have the faculty, when in a dry state, of contraction, when fissures or apertures are formed, through which the rain on its descent upon the surface of the earth can pass, and thus to a certain extent a natural surface drain is provided, till the soil becoming saturated with water, expands, and closes up these chasms, when the powers of absorption and percolation are rendered very inactive. When the land is in that state, it is that the art of the drainer is needed. Deep drains, if sufficiently close together, on the strong clay soils, will, if the work be well performed, work satisfactorily for a time, perhaps two, three, or four years, dependent upon the seasons, while the soil with which the drains are filled lies loosely upon the tiles; but when the earth has been subservient to the properties of contraction and ex-

pansion already noticed, and resumes its natural condition, the water fails to pass with sufficient freedom, and serious disappointment almost invariably succeeds. Let no man who cultivates a strong, retentive clay soil, who has expended £5 per acre in draining it four feet deep, in the fulness of his heart rejoice because the succeeding winter he finds the drains emitting a free discharge of water.

The impervious consistency which the clay returns to when the drains are refilled therewith, after a certain lapse of time, has induced me to devote much consideration to the subject, in the hope of adopting a more porous substitute. I have come to the conclusion that this may be successfully effected by burning the clay taken out of the drains, and using it after it has undergone that process for refilling them. By this method water will percolate through these artificial veins with as much freedom as through the lightest sand. Burning clay has been practised many years in Shropshire and the adjoining counties, for the purpose of dressing the land, in order to render it more friable. It is also adopted on railways, as a substitute for gravel.

To perform this effectually I propose that a surface of the burnt material be placed at the bottom of the drain, which should be compressed and made level with a light wooden implement about two feet long,

and of a proper width to fit the drain; let this layer of the burnt clay be from four to six inches deep; place the tiles carefully on that, and cover them with burnt clay, having reserved a sufficient quantity of the surface soil to cover the top. Forming a surface for the tiles to rest upon of material capable of free percolation is of great moment. It has been decided that the water passes into the drains from beneath, and never from above. This may appear paradoxical and inconsistent to many, and there may be those who are incredulous, but such is the fact. The water sinks through the earth and rises to the bottom of the drains by the laws of capillary attraction. From this cause I consider it imperatively necessary that the arrangement of the tiles should be effected in the manner described. It is, I believe, quite a new suggestion; at all events, I have never heard of its having been adopted; but I trust ere long to be able to speak of it in positive and satisfactory terms.

To draw off the deep or spring-water is not in all cases very readily accomplished. As it takes its course under the surface of the earth, that course may not be very readily discovered. In some cases a single drain may answer the purpose, but it may require to be five or six feet deep, or even more than that; and if there be only one spring, or, rather, subterranean reservoir, which affects the land, and that can

be discovered, one drain properly directed will produce, so far as that spring is concerned, all that is required.

There are several subjects connected with draining upon which practitioners are at issue; among these the most eligible size for pipes. Circumstances must here have influence. If the quantity of water to be drawn off is not very great, the small-sized ones, providing there is plenty of fall, will answer the purpose; but if the draught for the water be languid, and especially if there be danger at any time of the passage for the water being restrained by floods—back-water as it is termed—they are not to be relied upon. In those cases they soon become choked with extraneous matter; at the same time they are less susceptible of the intrusion of vermin. I have heard of draining-pipes being completely filled up with aquatic weeds.

The numerous varieties, and the very abrupt changes apparent in the soils in various counties in England, are so conspicuous, that it appears extraordinary that any persons should repose their belief upon an universal rule for the depth and arrangement of drains. In Berkshire and Hampshire, travelling from Reading to Basingstoke, the land is principally of a strong, tenacious character, resting on a bed of clay, through which water percolates very tardily. Traversing

from Basingstoke in a north-westerly direction, by Chinham, Sherborne, Wolverton, and thence to Kingsclere, the land on the right hand is of a similar nature to that already described; but on the left hand the surface is very much lighter, generally resting on a substratum of chalk, which is consequently dry. It was in this country, about eight or nine years ago, that I was first impressed with the conviction that deep draining on strong clay with one inch pipe tiles, was ineffective. I was riding over a field of arable land that I had seen when the draining was being carried on three years previously, and I found it as wet as it was before the drains were made. My curiosity induced me to investigate this, and I discovered that several of the drains did not act, and others discharged the water only to a trifling extent. The county of Salop affords examples of equal varieties. From Bridgenorth to Kidderminster, the land on the right of the road, bounded by the Severn, is principally a trong clay; whereas on the left of the road it is generally sandy, reposing on sandstone rock; and there is some eastward of Quatford, of the poorest quality imaginable. The sandy soil does not require to be drained, but there are many intervening spots which do, and I cannot conceive any thing more irreconcilable with reason than an argument that the same rules which are desirable on the above-named tract of clay land,

should be applicable to those wet parts which are sometimes found intermixed with the sandy district. Between Bridgenorth and Ludlow a similar quantity of clay prevails, and on the Brown Clee hill it is embedded principally on rock. To drain this land upon any system of equal depth, would be totally impracticable: the rock in many places forming basins which contain the water, must be cut into, and the depth determined by circumstances.

Much of the land in Gloucestershire likewise presents difficulties in draining it effectively, for there is an abundance of clay of a very tenacious quality, through which water percolates very tardily, and in this deep draining is not effective. Yet there are intervals and spaces where it does succeed. In the neighbourhood of Newent, there is much of the strong red clay; and I well remember an estate in an adjoining parish, which was drained more than thirty years ago, upon the most approved principles of the day, quite regardless of expense, which in less than ten years required the process to be repeated. So much for what is termed permanent draining.

It may be, I think, fairly asserted that we are on the eve of a new era in agriculture, by the introduction of steam power, for the purpose of cultivating the earth. This will lead to the adoption of deep tillage, wherever the nature of the soil will render it advis-

able; and as an auxiliary to draining, there can be no doubt of its value. On this account it will be expedient to lay drains at such a depth that they may not be disturbed in the process of cultivation.

The free percolation of water through the soil, and the action of the air upon the soil, are two very important operations of nature. It is by that means that the animal and vegetable matter contained in the earth is decomposed and rendered available as food for vegetation. With clay subsoils especially, deep tillage cannot fail to be productive of great benefit.

Somewhat apparently in opposition to this, however, and it might indeed be extended to the practice of draining, it has been discovered that the water flowing from a drain, after the land has been dressed with guano, afforded, by analysis, a greater proportion of ammonia than the water taken from the same drain previously to the application of the guano. This on the first glance appears to be a decided case against draining, but a little consideration dispels that opinion. There is no doubt that a portion of the fertilizing properties of manures is washed away by the water in its percolation through the soil, and that some other portions, those of a gaseous nature, escape by evaporation; still the absorbent properties of the earth enable it to retain a portion for the nutrition of plants, and it is not till after the water has carried it beyond the reach

of their roots, that it can find its way into the drains.

The advantages which may be derived from ventilation are but seldom embraced; but where the best fall that can be obtained is not satisfactory, there is but little doubt it may be brought into good effect. When water is pent up in the drains, by floods, and the pipes become surcharged, the admission of air from above cannot fail to be beneficial. I do not go quite so far as to compare the water in the drains to fluid in an air-tight vessel, or that ventilation is absolutely necessary when the pipes are not nearly filled with water. Cast-iron pipes fixed a foot above the surface of the soil, and communicating with the heads of the drains, may be provided at a trifling expense.

There are many situations where draining cannot be satisfactory accomplished from want of sufficient outfall, or what may be more emphatically denominated a general system of trunk drainage. The subject has been for some time a matter of consideration, but no steps have been taken for its performance. It is of national importance, inasmuch that every circumstance connected with the means of augmenting the production of food for the daily increasing population is an event of public interest. Whatever may be the situation of a field of land that is drained, the

water, by some means or other, must flow into the ocean, either directly or by means of the tributary streams which afford a course. As the draining of land diminishes the amount of evaporation, in an equal ratio, it increases the quantity of water that flows into the brooks and rivers. Besides this, the water passing off more rapidly, after a fall of rain, when the land has been drained, the flooding of tributary streams and their outlets is considerably augmented. This is already experienced in some situations to an inconvenient extent, although, comparatively speaking, only a small portion of the land in England requiring to be drained has, as yet, undergone that process. The extent of damage occasioned by flooding must necessarily increase as the practice of draining becomes more universally diffused, unless some measure be adopted to meet this difficulty.

The estuaries of rivers, in some instances, require to be cleared, and it is very necessary that all obstructions which retard the free course of water to the sea should be removed. To effect this, sweeping clauses have been advocated, the total annihilation of water mills standing prominently in the foreground. It must be admitted that there are many small corn mills on streams of little magnitude, that interfere with the progress of draining very materially, and to an

amount far greater than their intrinsic value. A compensation equivalent to the worth of such mills, would in most cases be more than repaid by the increased value of the neighbouring land after it had been properly drained. Nevertheless, it is a difficult subject to legislate upon; for it is evident that a distinction would be requisite between those mills which, by pounding up the water of the streams, present impediments to draining, and those which do not. Some of the mills on the large streams occasion no damage whatever, as they are worked by the force of water turned out of its course, without damming it up above its natural level.

There are other subjects requiring attention for the purpose of facilitating and regulating the operations of draining, so that the private rights of individuals may not on the one hand oppose the march of improvement; or on the other, that those rights shall not be vexatiously invaded. Legislative measures only can regulate these affairs. Clearing rivulets and ditches from aquatic weeds, rubbish, and extraneous matters of all kinds which interfere with the current of water, let them be situated on the property of persons whose land has been drained, or on that of a neighbour, ought to be permitted.

The question whether land can be overdrained is one that has been often mooted, and like other

subjects connected with draining, is a point at issue; much the same conclusions may be arrived at, as those which have already been given. In some few cases perhaps it may, that is on light soils, which percolate freely, and where the power of evaporation is consiable. Hence the theory of evaporation may be brought into effect with advantage. It may be urged that such soils cannot require draining, still there are exceptions. If it be injured in places, by water which lies under the surface, there cannot be a doubt upon the question. That water should be drawn away, but it may not be necessary, or desirable, to drain the whole field. Peaty soils may possibly be made too dry, and although alluvial soils are generally enrolled in the category of lands which do not require draining, nevertheless there are some which do.

An effective and profitable system of irrigation is in many parts compatible with draining, and yet those advantages are very commonly disregarded. But as the science and practice of draining is more universally extended, it may be expected that the twofold objects will be more united. It is not, however practicable in all cases, and in some others it may involve expenses which are not likely to be repaid.

During the progress of these pages through the

press, I accidentally discovered that a plan similar to that proposed by me, of filling up the drains in strong impervious soils, with burnt clay, had been previously adopted by James Croome, Esq. of Breadstone, near Dursley, Gloucestershire. Considering the value of a practical example I lost no time in making a call upon that gentleman, to ascertain the result, and his opinion relative to the practice. Mr. Croome entered upon the subject most courteously and with great minuteness, informing me that some of the work had been executed about five years, in other parts more recently, and all to his most perfect satisfaction. The only difference between the plan adopted by Mr. Croome, and that suggested by me, consists in this—he has not placed any burnt clay under the tiles, being apprehensive that workmen might not be sufficiently careful to make the surface for the tiles to rest upon, so perfectly level as to ensure their ranging exactly with each other. This is certainly a very important point, but providing the work is executed with precision, I am of opinion that the advantages arising from the tiles being laid on a bed of pervious material would vastly facilitate the passage of the water into the course required. Mr. Croome, whose vast experience in these matters commands the greatest attention, advocates four feet drains, filled with burnt clay, in the soils which generally prevail on

his estate, upon the principle, that when you arrive at that depth, you get through the impervious clay, to a soil of more loamy quality, and therefore more free of percolation. This view I am quite ready to accept, adhering in all cases to a standing practice, that the depth, width, and course of the drains must be subservient to the character of the soil. Mr. Croome considers the quality and making of draining pipes a subject of far greater importance than what is generally devoted to it; for when they are constructed with a soft sandy material, improperly burnt they soon perish, and the durability of the work is very seriously affected.

MANURING.

THE most casual observers of those beautifully arranged laws of Nature which provide for reproduction, both in the animal and the vegetable kingdoms, must be forcibly impressed with the wonderful order in which they are dispensed. The productions of the earth afford nutriment to living creatures, which in return promote the luxuriance of vegetation. It may be, not inaptly, compared to a vast system of circulation.

Previously to entering on the subject of manuring land, a few remarks concerning the food of plants, will serve to illustrate the supreme regularity by which one class of the creation is provided for the support of another, and also in the selection of the most appropriate applications for promoting that property in the soil.

It is understood that the principal elements from which vegetable productions derive nourishment, are nitrogen, carbon, phosphate of lime, and certain earthy substances, and salts, indigenous to the soil

in which they grow: and the former of these are contained in different proportions in all decomposed animal substances. The earth possesses the power of absorbing ammonia, which is one of the principal elements of nutrition, from the atmosphere, and a portion is also conveyed with rain. Earthy and saline matters comprising the food of plants, are supplied by a slow process of solution in the soil. Nature, in the first instance, provided for all these exigencies, and so far as her necessities require, continues to supply them. This may be explained by the growth of vegetation on uncultivated spots, but the tillers of the soil find it necessary to produce more than what the normal condition of the land will afford. As the population of the world increased, and as it continues to increase, it became necessary that man should extend his exertions to augment the produce of the earth, otherwise the means of existence would soon have failed.

As vegetation affords the means of support to the animal creation, so in return do the decomposed elements of animals contribute to the luxuriance of vegetation; these are the foundations upon which the replenishments of animal life depend. The science of chemistry has suggested many agents which can with good effect be called in aid of agriculture; these may be properly termed auxiliaries of value.

Chemistry has enabled the professors of that science to determine the constituent ingredients of the earth, and to trace corresponding elements in plants. Hence it is established that the earth must be in possession of a certain proportion of the specific elements which each plant contains to bring it to a state of perfection. In proportion as the soil contains a sufficient quantity, and in due ratio, each of the nutritive ingredients which the plants require, so will be the degree of luxuriance to which the crop is capable of being brought, subservient, however, to the influences of atmospheric causes. It is easy to comprehend that every crop extracts a given quantity of nutriment from the soil on which it grows; it may be supposed that, to promote luxuriance in the succeeding crop, the land again being supplied with elements similar to those which have been extracted, by the preceding crop, and the manure being of that kind which contains, in sufficient proportions, those ingredients which the specific nature of the successional crop demands, that the same crop may be grown year after year, but practice does not confirm this theory. All plants do not draw from the earth the same proportions of nutritive matter, or identical elements; and for this reason, the custom of changing the crops to meet these peculiarities, is adopted with the most satisfactory results.

The functions of animal and vegetable life are capable of comparison, more so than ordinary observation discloses. The earth not only contains the nutriment of plants, but it likewise performs the process of digestion. All the food must be reduced to a state of solution; it is in that condition absorbed by the small filaments or roots adapted to that purpose, from whence it passes into the body or stem. The branches or leaves perform the office of lungs, by contact with oxygen, when the sap having been purified descends through a different arrangement of vessels, passing into the earth as excrementatious matter. Those portions of food also, which are not suitable to the constitution of the plant, are returned to the earth, unless they be in excess, which occasions feebleness, and in some cases destruction. These faculties vary considerably in different plants. Beans, according to chemical discoveries, contain a greater proportion of nitrogenous, or flesh-forming element than wheat; thus it would appear that a crop of beans would exhaust the soil upon which it grows to a greater extent than wheat. But that it does not, is accounted for in this way. The bean has a larger leaf, and from that source, comparing the leaves of plants with the lungs of animals, it possesses the power of deriving a greater portion of its nourishment from the atmosphere than either wheat, oats, or

barley, which have comparatively small leaves. The peculiar structure of different plants, enables them to extract nourishment from the soil, or from the atmosphere in proportions widely different. Cereals are said to derive as much ammonia from the atmosphere as from the manure; but surely this must depend greatly upon the quality of the manure, and upon the climate. In the usual rotation of crops, beans are commonly planted preparatory to wheat, and with good success; yet practice and science are somewhat at issue respecting the exhausting properties of beans.

The following analysis by the late Professor Johnston, in his "Elementary Treatise of Agriculture and Geology," shows the component parts of 2,000lbs of the ash from the grain and straw of wheat, barley, oats, and beans, and of the potato and turnip root:

	Wheat	Barley	Oats	Turnips	Potatoes
Potash	362	228	453	419	557
Soda	93	84	97	51	19
Lime	95	111	141	136	20
Magnesia	159	125	138	53	53
Oxide of Iron.	20	25	24	18	5
Phosphoric Acid	531	421	464	76	126
Sulphuric Acid	61	11	138	6	136
Silica	666	949	511	79	42
Chlorine	11	6	35	36	42

Theoretically it is understood that the land intended

for the cultivation of these crops must contain in due proportions the substances of which the plants are composed, or ingredients which by chemical changes are capable of forming them in combination with the component parts existing in the soil. It is to introduce those which are wanting, that the process of manuring is adopted; and the choice of suitable manures to supply the deficient elements is one of the first considerations connected with good farming.

From what has been already suggested, it will be seen that the successful selection of appropriate fertilizers will depend upon the nature of the soil, in other words, the elements it contains, taking into consideration the extractive properties of the previous crop, and the requirements of the one about to be cultivated. Chemistry will materially assist in this, but practical experience and knowledge of the peculiarities of the soil and climate will, on all occasions, prove a most valuable monitor. The abstruse operations of nature, in some cases, perplex the deepest researches of science, for although that which has been already stated concerning the requirements of plants may be adopted as a general principle, it is not without exceptions.

In the observations which I propose to offer on the subject of manuring land, it is not my intention to advocate the use of expensive applications which

may be productive of enormous crops, but which cannot be expected to leave a margin for profit. The subject involves so much importance, that an almost endless number of experiments have from time to time been resorted to, many of them chimerical in the extreme, and the experimentalizers have frequently advocated their systems with romantic enthusiasm. Those who desire to farm for profit, must distinguish where to draw the line between parsimony and excess. I would not for a moment be supposed to undervalue the exertions of those who have conferred so many benefits upon the culture of the soil, as they have, who, being possessed of wealth and enterprize, have kindly devoted much of their capital and skill to the praiseworthy purpose of introducing new methods of providing for the wants of mankind.

Placing farmyard manure in its proper station, first on the list, it must be acknowledged that many very valuable methods have of late years been introduced in the composition, or as it is more emphatically expressed, the manufacturing of the dung heap. I can well remember that it was a very common occurrence to see a farmyard formed like a basin, hollow in the middle, that it might retain the rain which descended thereon, including also the water which poured down from the roofs of the surrounding buildings. It is but a few years since, I was incautiously

in the act of riding over one of these quagmires, which consisted of a bed of straw three or four feet deep, floating on water; and had it not happened that I quickly discovered by the waving undulations, resembling those of a bag, the treacherous nature of the compost into which I was steering, there is no doubt my horse would have been injured. It was an old-fashioned notion, that a quantity of water was essential to the decomposition of the straw, and that it must be submitted to submersion, without taking into consideration that the nitrogen, the carbon, and all the valuable elements were extensively destroyed, or carried away by the aquatic process. The water in these cases contained the most valuable properties, and that was allowed to find its way to the nearest stream, and although these eccentricities are not of such common occurrence as in bygone days, it is truly lamentable to observe the vast quantites of liquid manure which are permitted to run to waste. It is urged by some, that the water from farmyard manure, when conveyed to the land by means of pipes and hose, is more beneficial to the crops than the manure itself, and plans have been adopted to carry it into effect; the consideration of this I must reserve to a future opportunity.

The succeeding step to improvement in the mode of manufacturing farmyard dung was that of laying the

surface of the yard in such a form that the water should pass off as quickly as possible, tanks being in some cases prepared for its reception; the eaves of the buildings being provided with gutters to carry the rain which descended upon them into proper drains, and thus no more water came in contact with the manure than the rain which fell thereon. Advancing upon this, the plan of making the manure under covered homesteads, or in the buildings in which the stock is housed, finds, many advocates, with whom others are at issue, respecting the advantages on the one hand, and the objections on the other.

The value, or strength of farmyard manure is influenced by two circumstances; the kind of food upon which the animals are fed, and the manner adopted of manufacturing the manure. It is well known that when the animals are kept upon grain, oil-cake, and such like nitrogenous aliment, their dung is more powerful than when they are supplied with nothing better than hay, straw, roots, or grass. The manure which will yield the heaviest crops is that which contains the greatest amount of ammonia and phosphate of lime. Farmyard dung may nevertheless be formed at a price too costly; but the great desideratum is to economize its valuable properties, by not allowing them to escape, and securing them in the substance. With reference only to the strength of

the manure, the materials from which it is formed being equal when it is made under covered homesteads, or suffered to remain several weeks under horses and cattle in stables and boxes, there is no doubt it exceeds that which is made in the open air. The effect it produces on the health and condition of the stock is the only objection; and that being a most important one, will be found again referred to in the observations on Cattle.

The proper management of the manure heap requires considerable attention. Sir Humphrey Davy recommended this to the farmers half a century ago, but his good advice was very little heeded. If the fermentation becomes excessive, a considerable quantity of ammonia is formed, and its volatile or gaseous properties quickly escape, but if the fermenation is insufficient, the elements of nutriment are not thoroughly obtained. The importance of regulating the amount of fermentation is therefore apparent. Manure that is made under cover requires to remain in that state until it is removed to be worked into the land, otherwise an immoderate renewal of fermentation takes place, and a great amount of ammonia escapes. The reason why manure is stronger when made under cover, may be thus explained. The urine forms one of the most active agents, and not being weakened by water, its power is not diminished;

also the ammonia is less subservient to the action of the elements, therefore less likely to be expended. If the re-removal of the manure from the yards to the fields some time before it can be worked into the land is imperative, it should be completely covered with soil to retain the ammonia. I believe, however, the combined actions of manure and the earth are not thoroughly understood; for observation, leads me to the conclusion that manure possesses the power to a certain extent of generating ammonia after it is worked into the land, depending upon the constituents of the soil, and the quantity of nitrogen or ammonia forming ingredients contained in the manure, and by its affinity, absorbing it from the atmosphere. When buried in the soil, a portion of its invigorating power lies dormant till it is submitted to the action of the atmosphere, accelerated by ploughing or some other means of cultivation.

The management of the manure heap is daily becoming more and more appreciated. The admixture of soil in considerable proportions is attended with the best effects. Being applied in alternate layers, it checks excessive fermentation at the same time that it is an absorbent of ammonia. The slow putrefaction of animal and vegetable substances as ordained by nature for the reproduction of vegetation should in this instance be the guide; and yet

the very reverse of this is often produced by the indiscreet management adopted, whereby an unnecessary expenditure of the most valuable of those substances is promoted. To secure all the nutritive properties contained in the manure, in the form of ammonia, is impossible; in a gaseous state it is of a character too volatile to admit of that; but it is desirable to husband the greatest quantity possible. When an excessive degree of heat or fermentation is established in the dungheap, a great amount of evaporation takes place, which carries off a large portion of ammonia, and it (the great heat) destroys a considerable quantity of the nitrogen, the basis of ammonia, which cannot be reproduced, although so long as there is nitrogen in the manure, when it is applied to the land, in the same ratio it will be given forth to that land. Of the two an insufficient amount of fermentation is less objectionable than excessive heat. I have dwelt upon this subject from a conviction of its importance.

When dead animals or vegetable substances are consigned to the earth, under ordinary circumstances decomposition takes place slowly but surely, and during the process they yield all the nitrogen they contained in the form of ammonia. If that decomposition be extensively promoted in the dungheaps before it is applied to the soil, it is obvious that it must be deprived of a vast amount of its fertilizing

property. In forming nitrogenous manures, the great object is to preserve the ammonia with the utmost caution.

In farmyards it very frequently happens that the manure from the stables occupies one portion, that from the cattle-sheds another, and that from the pigs a third, whereas all should be regularly distributed.

Bousingault's analysis of manures gives the following proportions.

	Farmyard dung.	Horse dung.	Cow dung.	Pig dung.
Moisture	76,30	7·,17	86,44	82,00
Organic matter	14,03	19,70	11,20	14,29
Inorganic matter	6,67	4,13	2,36	3,71
	100,00	100,00	100,00	100,00
Nitrogen	0,41	0,65	0,36	0,61
Ammonia	0,49	0,78	0,43	0,64

By the term farmyard dung it is to be presumed M. Bousingault means a general compost from the stables, cattle-sheds, and piggeries. The horse dung, from the quantities of organic matter, nitrogen, and ammonia it contains, is the most valuable; that from the pigs the next, that from the farmyard the next, and that from the cows the least. To have rendered this information more satisfactory, the food upon which the animals were kept should have been specified.

Farmyard manure may be applied to all kinds of

crops with the greatest advantage alike to grass, grain, or roots. It is essentially the decomposed vegetable matter of plants which grew on the soil; it contains the nutriment of all the plants we cultivate, and it is therefore the best adapted for reproducing them; but it cannot be, at all events it is not, obtained in quantities sufficient for the purpose. If, however, every farmer devoted his best energies to the cultivation of the manure that is capable of being collected, studiously economizing also the liquid which flows therefrom, the demand for artificial or foreign productions would be very materially diminished. This at the present crisis demands the most serious attention. Taking under review the customs adopted not by the most enterprising and enlightened agriculturists of the day, yet by the majority, the deficiency in the aggregate quantity and value of manure is easily accounted for. I will take the county of Hants, and part of Gloucestershire as instances, because they afford examples of opposite customs, each of which are irreconcilable with reason. In Hampshire the land to which I refer is arable; no stock is kept, with the exception of a certain number of agricultural horses, sheep, and pigs. The sheep are folded on the land, therefore they do not contribute to the reduction of the immense bulk of straw which is produced. On a farm of five or six hundred

acres, twelve or fourteen horses may be employed; and during the year from sixty to a hundred pigs may be kept, but collectively they are quite insufficient to convert the straw into manure, the greater portion of which in course of time is returned to the land undecomposed or enriched by any means whatsoever. Considerable quantities of artificial manures are therefore used.

If you reason with a Hampshire farmer of this class on the advantages of stall-feeding, or keeping a store-stock for the purpose of contributing to the manure heap, he is perchance totally unacquainted with the process, or he tells you his land will not produce roots containing sufficient nutriment. But that is a phantom of his imagination. In the dairy districts of Gloucestershire this is totally reversed. Where fifty or sixty cows are kept, it often happens that the farm is almost entirely devoted to grass, little or no grain is cultivated, therefore there is no straw, and the dung from the cows is either deposited by them on the land, or what is collected in the yards is carted out, without the augmentation of straw, and thus the advantages of a well-formed dung heap are not secured.

For the purpose of testing the comparative value of farm-yard dung and guano for the cultivation of turnips, a series of most interesting experiments

were conducted a few years since by Mr. William Goodlet, factor to Lord Blantyre, Erskine, Renfrewshire.

They embrace so many details of interest, both with reference to manuring, the culture of turnips, and the feeding of cattle, that I am induced to insert the whole of the report as it appeared in the "Transactions of the Highland Society:"

"A portion of a field of twenty acres, on the farm of Beauchamp, in Forfarshire, intended for turnips last year (1850), was selected for its equal quality of soil and exposure, upon which to grow the lots to be experimented with. The soil is a good friable loam, and the field, which had been manured for a bean crop in 1848, was in wheat in 1849, and ploughed in the autumn, with a good furrow, for turnips in the following season.

Plot No. 1 got 20 tons of well-made farm-yard dung per acre.
„ No. 2 got 4 cwt. of Peruvian guano per acre.
„ No. 3 got 10 tons of like dung, 2 cwt. of like guano per acre.

"The turnip seeds—Skirving's purple-top yellow—were sown on the 26th of May. They brairded pretty much alike; those with guano continued throughout the season to show rather most luxuriance of growth; but on the crops arriving at maturity little or no difference was discernible between them.

"From the commencement of the experiment, on the 21st of October, to its close on the 10th of March, the cattle in

Lot	Tons.	Cwt.	Qrs.
1 consumed 3 acres, 2 roods, 27 poles, weighing	96	14	1
2 ..... 3 ..... 2 ..... 4	96	13	1
3 ..... 3 ..... 2 ..... 11	96	10	0

"The turnips were brought from the field as required, about an eight-days' supply usually being in store, and from first to last they were taken clean and in good order from the field, the tops and roots being left behind. They were given to the cattle by weight and measure.

"The cattle experimented on were a lot of two-year-old short-horn crosses, reared by Sir John Dunbar, in Caithness-shire, brought from the grazings a considerable distance; and after being allowed a little time to recover from the fatigue of their journey, were, on the 21st of October, carefully divided into three lots of seven each by competent judges, weighed, and put into their respective feeding courts, which are exactly of the same form and construction, having each ample shed-room in a building on their north side, and being surrounded by high walls on the other three sides, with feeding-troughs in the open court for turnips, racks within the sheds for straw, and a southern exposure. Lot 1 was put on the turnips, grown with dung alone; lot 2 on the tur-

nips grown with guano alone; and lot 3 on turnips with half dung and half guano.

"The weather was fine and dry when the cattle were put up, and continued so till towards the latter end of December, about the beginning of which were a few days of dull, hazy weather, inclining to frost, and during its continuance all the lots ate about thirty-five pounds less turnips each beast per day than usual; about the 30th of December much rain fell, and till the 13th January it continued very wet. The cattle were observed to scour a good deal, and ate very little straw; indeed from the beginning the consumption of straw was very small. It was then deemed advisable to give them hay. The average consumption of turnips till this time was two hundred and twenty-seven pounds each beast per day; but after being put on hay, of which they were allowed as much as they ate up clean (eleven pounds each beast daily), the average consumption of turnips decreased to two hundred and sixteen pounds each beast per day. At the end of the fourth month (that being the shortest period allowed by the terms of competition for the experiment with turnips alone) it was resolved to give them a small allowance of oil-cake, in order to see the effect it might have on hastening forward their fattening. Accordingly two pounds of oil-cake were allowed to each beast daily,

along with their hay and turnips; after which the consumption of turnips fell to two hundred and nine pounds, and of hay to ten pounds each beast per day, and it continued at that rate till the close of the experiment.

"During the wet weather in the beginning of January, three of the cattle, one of each lot, No. 2 of lot 1, No. 4 of lot 2, and No. 2 of lot 3, were not doing so well, and were bled, and got each a dose of salts. They soon after recovered, and made up to the others, the bleeding and medicine having no permanently bad effect in retarding their feeding; but on the contrary, seemed to give an impetus to it after they recovered from the immediate effects of their medical treatment.

"All the cattle of each lot were weighed once every four weeks, and four of each lot were weighed once every fortnight. The weighing invariably took place between the hours of three and four o'clock in the afternoon. It was feared the frequent weighings might disturb the animals, and probably have an adverse influence on their fattening; and it was thought that weighing the same four fortnightly would be sufficient to test the progressive improvement, and that the bad effects, if any, from the weighings would be seen by contrast with the other three of each lot which were weighed only once a month. It may be

mentioned, however, that the cattle generally were very tractable, and by the end of the experiment the weighing seemed to give them no uneasiness, the cattle man leading them on by their horns to the weighing machine with the greatest care and composure possible. The following tables show the progressive improvement in weight during the experiment.

TABLE I.

Shewing the increase in weight in pounds at the end of every four weeks, from the commencement of the experiment on the 21st of October, to its close on the 10th of March.

Lot 1—Fed on turnips grown with dung alone.

No.	Nov. 18.	Dec. 16.	Jan. 13.	Feb. 10.	Mar. 10.	Total increase.
	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.
1	66	112	96	104	136	514
2	60	85	90	18	107	360
3	64	65	118	30	123	400
4	56	104	92	44	78	374
5	52	61	74	14	60	261
6	59	66	38	66	67	296
7	46	51	85	90	61	333
	403	544	593	360	632	2,538

Lot 2—Fed on turnips grown with guano alone.

No.	Nov. 18.	Dec. 16.	Jan 13.	Feb. 10.	Mar. 10.	Total increase.
	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.
1	58	54	89	61	84	346
2	71	92	96	59	86	404
3	76	50	77	33	28	264
4	43	41	84	78	111	307
5	80	67	83	48	58	336
6	50	57	91	30	111	339
7	54	57	79	60	72	322
	432	418	549	369	550	2,318

Lot 3—Fed on turnips grown with half dung and half guano.

No.	Nov. 1	Dec. 16.	Jan. 13.	Feb. 10.	Mar. 10.	Total increase.
	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.
1	33	88	99	113	134	467
2	54	85	73	69	98	379
3	31	59	65	46	76	277
4	54	74	105	87	78	398
5	45	82	60	55	42	284
6	29	52	56	43	108	288
7	25	48	64	66	139	342
	271	488	522	479	675	2,435

TABLE II.

Showing the increase in weight every fortnight of four of the cattle of each lot from the 21st of October to the 10th of March.

"Cattle of Lot 1, weighed and put up on the 21st of October, and weighed again on—

No.	Nov. 4.	Nov. 18.	Dec. 2.	Dec. 16.	Dec. 30.	Jan. 13.	Jan. 27.	Feb. 10.	Feb. 24.	Mar. 10.
	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.
1	26	40	46	66	30	66	54	50	44	92
2	24	36	54	31	39	51	lost 5	23	41	66
4	28	28	38	66	36	56	29	15	25	53
6	41	18	28	38	18	20	26	40	18	49
	119	122	160	201	123	193	104	128	128	260

"Cattle of Lot 2, weighed and put up on the 21st of October, and weighed again on—

No.	Nov. 4.	Nov. 18.	Dec. 2.	Dec. 16.	Dec. 30.	Jan. 13.	Jan. 27.	Feb. 10.	Feb. 24.	Mar. 10.
	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.
1	24	34	26	28	48	41	44	17	24	60
2	23	48	33	59	38	58	28	31	13	73
4	28	15	14	27	32	2	23	55	28	83
6	21	29	27	30	46	45	7	23	46	65
	96	126	100	144	164	146	102	126	111	281

"Cattle of Lot 3, weighed and put up on the 21st of October, and weighed again on—

No.	Nov. 4.	Nov. 18.	Dec. 2.	Dec. 16.	Dec. 30.	Jan. 13.	Jan. 27.	Feb. 10.	Feb. 24.	Mar. 10.
	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.
1	17	16	29	59	47	52	55	58	46	88
2	19	35	18	67	35	38	38	31	47	51
4	22	32	28	46	56	49	45	42	29	49
6	20	9	27	25	31	25	5	38	36	72
	78	92	102	197	169	164	143	169	158	260

According to Table 1, Lot 1 fed on turnips grown with dung alone, produced an increase in the live weight of	2,538 lbs.
And Lot 2, fed on turnips grown with guano alone produced an increase of	2,318 ,,
Making a difference of . . .	220 ,,

"Assuming six-tenths as equal to the dead weight, we have 132 lbs. estimated at 5d. per lb. equal to 55s. as the increase in money value on the lot, or an average of 7s. 10¼d. for each beast; and there being 3 acres, 2 roods, 27 poles of turnips consumed by this lot, the advantage in favour of the dung-grown turnips is equal to about 15s. 7d. per acre.

"The lot fed on the turnips grown with half dung and half guano held an intermediate position between the other two lots, and fairly leads to the inference which they support that dung-grown turnips have an advantage in feeding qualities over those grown with guano, although that advantage, as shown by the experiment, is not so great as to compensate for the greater cost of dung, and the ready facilities afforded by guano for growing a much larger extent of turnips on the farm than could be done if farmyard manure alone were used. Assuming the other expenses of the turnip crop grown with different manures to be equal, the cost for dung in this experiment is at 5s.

per ton, £5 per acre; for guano, £2 per acre, and for half dung and half guano, £3 10s.; so that, unless the subsequent crops make up for this difference of cost, a loss of £3 per acre, minus the 15s. 7d. per acre gained in feeding, as shown above, will give the results of growing turnips with dung instead of guano for feeding cattle. It might have been desirable to have had the dead weight of the animals, and also a test, by chemical analysis or otherwise, of the comparative qualities of the beef for table; but they were sold to a dealer for a distant market, and these could not be obtained.

"Independently of the more direct results brought out by this experiment, there are two collateral points illustrated by the tables worthy of remark.—The first is in reference to the effect which the state of the weather has on feeding cattle in open courts. It will be seen that after the continued wet weather in the beginning of January a very serious check took place in the progressive increase of weight among all the lots—some of the cattle making little or no progress for nearly a month, and the general increase falling in Lot 1 from 593 to 366, and in Lot 2 from 549 to 369. In Lot 3 the deficiency is not so marked, but still sufficient to show that in open court feeding there is this disadvantage attending it in wet unsuitable weather, even although the cattle have ample

cover under sheds, if they choose to avail themselves of it. The other fact strikingly established by the tables is the great benefit derived from giving cattle even a small allowance of oilcake along with their turnips. Although during the last four weeks only 2 lbs. per day were given to each beast, the increased weight gained by all the lots exceeded that of any of the four previous months, especially that of Lot 3, which does not appear to have suffered so severe a check from the weather in the previous month as the other two lots, the highest increase of that lot before getting the oilcake being 522 lbs. per month, while during the month it was given the increase was 675 lbs.

"The following table exhibits the weight of the cattle at the commencement and close of the experiment, and their increase in weight during it.

Lot 1.

No.	Weight on Oct. 21.	Weight on Mar. 10.	Increase during the experiment.
	Cwt. qrs. lbs.	Cwt. qrs. lbs.	Cwt. qrs. lbs.
1	12 3 0	17 3 10	4 2 10
2	10 1 14	13 2 10	3 0 24
3	9 2 21	13 1 1	3 2 8
4	10 0 0	13 1 10	3 1 10
5	10 2 24	13 0 5	3 1 9
6	10 3 25	13 2 13	2 2 16
7	10 3 13	13 3 10	2 3 25
	75 1 13	98 0 3	22 2 18

Lot 2.

No.	Weight on Oct. 21.			Weight on Mar. 10.			Increase during the experiment.		
	Cwt.	qrs.	lbs.	Cwt.	qrs.	lbs.	Cwt.	qrs.	lbs.
1	12	3	0	15	3	10	3	0	10
2	12	0	5	15	2	17	3	2	12
3	9	3	0	12	0	12	2	1	12
4	10	1	0	12	3	27	2	2	27
5	10	3	22	13	3	22	3	0	0
6	10	3	7	13	3	10	3	0	3
7	10	2	0	13	1	14	2	3	14
	77	0	6	97	3	0	20	2	22

Lot 3.

No.	Weight on Oct. 21.			Weight on Mar. 10.			Increase during the experiment.		
	Cwt.	qrs.	lbs.	Cwt.	qrs.	lbs.	Cwt.	qrs.	lbs.
1	11	0	23	15	1	14	4	0	19
2	11	0	12	14	1	27	3	1	15
3	10	1	23	12	3	20	2	1	25
4	10	1	22	4	0	0	3	2	6
5	10	1	11	12	3	15	2	2	4
6	11	1	0	13	3	8	2	2	8
7	12	1	3	15	1	9	3	0	6
	77	0	10	98	3	9	21	2	27

"The cattle were bought in October, 1850, at £12 5s. a-head, and valued, when put up to feed, at £12 17s. 6d. a head. They were sold, with the exception of two (No. 3 in lot 2, and No. 3 in lot 3), on the 10th of March, for £16 10s. a head. The two reserved were at that time estimated to be worth

never under sheds, if they choose to avail themselves of it. The other fact strikingly established by the tables is the great benefit derived from giving cattle even a small allowance of oilcake along with their turnips. Although during the last four weeks only 2 lbs. per day were given to each beast, the increased weight gained by all the lots exceeded that of any of the four previous months, especially that of Lot 1 which does not appear to have suffered so severe a check from the weather in the previous month as the other two lots, the highest increase of that lot having the oilcake being 5.22 lbs. per month during the month it was given the increase was 6.3 lbs.

"The following table exhibits the weight at the commencement and close of the experiment, and their increase in weights [illegible]

Lot 1.

No.	Weight on Oct. 21.	Weight on Mar. 31.
	Cwt. qrs. lbs.	Cwt. qrs. lbs.
1	22 3 0	32 3
2	20 3 0	
3		
4		

Lot 2 ... how greatly ... he same breed ... even beasts kept ... lone, is 362½lbs., ... beasts was nearly ... riment commenced, ... , that these beasts were ... diarrhœa during a rainy ... about ten weeks after the ... riment, which must have ... influence on their thriving. ... disorder originated from two ... tion of the atmosphere, and the ... turnips, which, combined, occa- ... the alimentary canal. With de- ... management, under such circum- ... quantity of barley-meal given to ... ly, would have been the most rational ... that might not have been in accord- ... terms of the experiment. Such ... food, in ordinary cases, are the best reme- ... condition of animals should, at all times, ... ally watched, and their food regulated accord- ... the indications of the digestive apparatus and ... bowels. The quantity of turnips consumed by ... beast was profuse, and quite calculated to pro-

No.	Weight on Oct. 21.			Weight on May 10.			Increase or decrease during the experiment.		
	Cwt.	qrs.	lbs.	Cwt.	qrs.	lbs.	Cwt.	qrs.	lbs.
1	12	3	0	15	3	10			
2	12	0	5	15	2	17			
3	9	3	0	12	0	12			
4	10	1	0	12	2	27			
5	10	3	22	13	0	22			
6	10	3	7	13	0	7			
7	10	2	0	12	3	14			
	77	0	6	97					

No.	Weight on Oct. 21.			Weight on May 10.			Increase or decrease during the experiment.		
	Cwt.	qrs.	lbs.	Cwt.	qrs.	lbs.	Cwt.	qrs.	lbs.
1	11	0	27						
2	11	0	1						
3	10								
4	10								
5									
6									
7									

£15 a head. The cattle were sold in slump; but it was considered, both by buyer and seller, that lot 1 was worth from 6s. to 8s. a head more than the other lots, which opinion coincides with the results furnished by the weights already given."

The results of these experiments are very instructive, they instigate reflection and inquiry, and they illustrate many valuable theories. It will be observed that the guano had the effect of producing a precocious luxuriance of vegetation pleasing to the eye, but not quite faithful in promise, as the inferior value of the feeding properties of the turnips raised with that application clearly testifies. This leads to the remark that the feeding properties contained in the productions of the soil are specifically influenced by the manure made use of, and those elements of vegetable nutriment indigenous to the soil; likewise, which has been proved by many other experiments, the nutritive value of farmyard manure is influenced by the quality of the food consumed by the animals which produce it.

Table No. 1 is extremely instructive when it is required to be known the probable increase in the weight of animals when kept on the same kind of food. The maximum of weight, as it will be seen by this table, which a beast acquired in twenty weeks, is 514lbs., and the minimum 261lbs.; this is certainly

a great difference, but it serves to confirm how greatly the thriving properties of animals of the same breed vary. The average increase of the seven beasts kept on turnips, produced from manure alone, is 362¼lbs., and the aggregate weight of those beasts was nearly 1 cwt. 3 qrs. less when the experiment commenced, than that of the other two lots.

It must be noticed, however, that these beasts were attacked, more or less, with diarrhœa during a rainy interval which supervened, about ten weeks after the commencement of the experiment, which must have exercised a prejudicial influence on their thriving. It is evident that this disorder originated from two causes, the wet condition of the atmosphere, and the watery nature of the turnips, which, combined, occasioned irritation in the alimentary canal. With deference to the management, under such circumstances, a small quantity of barley-meal given to each beast daily, would have been the most rational practice; but that might not have been in accordance with the terms of the experiment. Such changes of food, in ordinary cases, are the best remedies; the condition of animals should, at all times, be carefully watched, and their food regulated according to the indications of the digestive apparatus and the bowels. The quantity of turnips consumed by each beast was profuse, and quite calculated to pro-

duce the disorder spoken of, until the effects were regulated by the introduction of more stimulating food. The average proportion of turnips, for two years' old steers, ought not to exceed 1 cwt. per diem, with straw, and the minimum allowance to these was nearly double that quantity. It was, therefore, a most conclusive experiment, as to the feeding properties of turnips grown from farm-yard dung and guano.

I cannot conclude this subject without taking exceptions to the estimate of £5 per acre for farm-yard manure. If farming accounts are kept upon the principle of estimating what everything would cost, in the event of being purchased, when the commodity is raised upon the farm, the farmer's balance sheet will make him appear to be wofully in debt at the end of the year. That which is produced and consumed upon the farm must be valued at the cost of its production. But even valuing the farm-yard dung at £5 per acre, there is a very important fact to be taken into account. Guano is of that transient nature, that its benefits are only available for one crop; and more than that, its stimulating properties are of that nature as to cause the crop to exhaust the soil most materially, without contributing *per se* to the nourishment of the future crop. This is not the case with farm-yard dung, which will confer its be-

nefit on succeeding crops in proportion to the retentive quality of the soil. On ordinary soils, turnip and barley soils, when twenty tons of farm-yard dung is applied to the acre for turnips, part of the turnips being fed off with sheep, that suffices for the following crop of barley, and the clover which succeeds. The £5 per acre, accepting that sum as the value, has to be divided between three crops, and the estimate will be materially changed. £1 13s. 4d. will represent the value of the manure exhausted by the turnips, or 6s. 8d. less than the cost of the guano; that amount added to the sum of 15s. 7d. mentioned in the report of the experiment as the extra value of the dung-raised turnips, establishes the advantages arising from that manure in preference to guano at the rate of £1 2s. 3d. per acre. The question of carriage—that is the distance from the manure heap to the land—is of course a necessary consideration in calculating the cost of farm-yard manure.

Ammonia and phosphate of lime are two of the most essential elements required for the nourishment of plants; therefore, whatever manure may be selected, it is imperative that the soil be supplied with these ingredients in some form or other. Mistakes are sometimes made in the selection of artificial manures, and disappointment must follow, because they do not contain, or have not the power to form

those ingredients of which the soil is deficient, but which are required for the luxuriant production of certain crops; but this is seldom the case with farm-yard mannre. The various capabilities which different soils possess of converting certain manures into food for plants, is a phenomenon well known to all persons conversant with farming; different kinds of soil have, also, the power of retaining the specific elements of nutriment in different proportions. Hence the character of the manure requires to be varied in conformity with the nature of the crop to be cultivated and the peculiarities of the soil—in other words, the ingredients which it contains. Among the retentive soils, are clays, loams, and land of an adhesive nature; those of the other class are sands, chalks, and gravels.

In proportion to the porous condition of the soil, so are the elements contained in manures more speedily effected by atmospheric causes; from this cause manure decomposes more rapidly in light soils, and dispenses its virtues more quickly to the young crop. It is therefore not necessary in such cases to supply manure in such large proportions, but the applications must be more frequent than on stronger and more retentive soils.

The introduction of guano into this country, as a manure, is of very recent date, although it is mentioned by Sir Humphrey Davy at the early part of the present century, and it has been known to

have been used from a very remote period on the arid soils of Peru. Sir Humphrey Davy recommended the use of the dung of sea birds, but believed it had never been adopted in this country. He mentions having received specimens of guano in 1805, which he says, from its composition, might be supposed to be a powerful manure. There were evidently at that time many obstacles to the conveyance of such a commodity, which the facilities of transmission, resulting from modern inventions and enterprise, have removed. Within the last fifteen or sixteen years large quantities have been imported, and it is estimated that the enormous sum of two millions sterling is annually expended. That it has gained immense favour with agriculturists, no additional testimony is required. It is of all other applications that are applied to the land, the most concentrated, and consequently well adapted for hilly districts, where the carriage of more bulky materials is inexpedient, and in some cases impracticable. The highly stimulating properties of guano interdict its use except in small quantities, otherwise, instead of improving, it would have the effect of destroying the crop. It is of a very transient nature, and therefore requires to be frequently renewed. As an agent or auxiliary to farm-yard manure, it is good, but being deficient of lasting properties it cannot be received as

an application of permanent value. Genuine Peruvian guano is a valuable importation when farmyard manure cannot be procured in sufficient quantities, and it is more powerful than the droppings of birds on the islands of Great Britain, as the former is collected in a very dry climate, consequently most of the soluble ingredients are retained, which is not the case with similar productions in more humid atmospheres; neither do any of our islands afford it in any quantities.

It is generally supposed that Peruvian guano, when genuine, consists exclusively of the droppings of birds, but well-authenticated information declares it to be a combination of their fœcal deposit, the refuse fish with which they feed their young, and decomposed animal matter, the remains of amphibious creatures which frequent those shores.

The following table gives the proportions contained in a fair specimen of Peruvian Guano:

Water	14.31
Ammonia	17.00
Organic matter . . .	33.23
Alkaline salts . . .	5.449
Phosphates . . .	25.543
Salts of lime . . .	9.968
Sand	1.50
	100.000

It will be seen by the above table that ammonia and phosphates comprise rather more than 2-5ths of the ingredients, and they are ascertained to be the two elements most essential to the growth of plants. The organic matter, I presume, contains also nitrogenous materials.

The extatic encomiums which some of the advocates for guano have displayed, concerning its fertilizing properties, are truly prodigious. Without desiring to detract from the *true* value of this application, I cannot avoid the remark that I believe it to be somewhat over-rated. The account already given, at Lord Blantyre's, of the experiments on the feeding properties of turnips grown with farm-yard dung and guano, lead to confirm this. That it promotes the early luxuriance of the crop to which it is applied, I am ready to admit, at the same time it leads to great exhaustion of the soil; and I will introduce an example. In 1855 a very near neighbour applied guano at the rate of three cwt. per acre with fifteen tons per acre of farm-yard dung, for mangle wurtzel; he had an excellent crop, estimated at forty tons per acre. The succeeding year he planted the same field with potatoes, for which he again applied twenty tons of farm-yard manure per acre. The result was a miserable crop of only sixteen sacks to the acre, and a considerable proportion of them was diseased, and

very small. The potatoes which grew on adjacent lands were fair crops, and much more free from disease; but those lands had never been treated with guano. The soil to which this case refers is a fair loam, on a clay subsoil, and in previous years has produced more than ten times the quantity of good-sized potatoes.

There are several anomalies respecting guano which I am unable to expound.

It is described as being of a very volatile nature; that of course refers principally to the ammonia.

This being admitted, what an enormous proportion of that evanescent gas it must contain in its original state, calculating that every removal and consequent exposure to the atmosphere must occasion more or less of expenditure. First, there is the removal of the substance from the places where it is deposited, to the vessel which conveys it to these shores; then the removal from that vessel to the warehouse of the importer. It may there be put into sacks, but that is not always done. It is again frequently consigned to an agent for retail sale, and it has to undergo further exposure to the atmosphere in the possession of the consumer before it is applied to the land. This is the inference which arises from chemical analysis; but it is my belief that a portion of the fertilizing properties of guano consists of some powerful

element possessing a great affinity for ammonia, when it is combined with the soil, and that it is not entirely dependent upon the amount of true ammoniacal substance indicated by analysis. The salts of ammonia have presented peculiarities and discrepancies to chemical investigations, and this subject is not satisfactorily expounded. An action somewhat analogous may be ascribed to farm-yard dung, but less violent; besides which, it is combined with vegetable matter, a most important substance, of which guano is totally destitute. The vegetable matter supplies nutriment of the most healthful character to succeeding crops. If farm-yard manure did not possess some power of regenerating ammonia, or some other element of nutriment when it is incorporated with the soil, its invigorating properties would be most extensively reduced after being exposed to the action of sun and wind for several days, nay weeks, as may be too often noticed on the lands of careless farmers. That it loses a great proportion of its value there can be no doubt, but it certainly does not lose all. The thesis of chemical composition and decomposition is not yet thoroughly demonstrated. There are certainly elements contained in soils varying in their proportions, which absorb ammonia from the atmosphere and from rain, and there are other ingredients and causes which effect

its liberation, otherwise the earth in process of time would become surcharged with ammonia.

With respect to guano, it may be urged what is the ultimate difference, whether the constituent parts consist of seventeen per cent. of ammonia in substance, or whether, by its affinity for ammonia, collecting that gas in the soil, it is productive of luxuriant crops. To this I reply, that if it contained ammonia in substance it would impart more lasting benefit to the soil; on the other hand, by collecting or stimulating to action the ammonia contained in the soil to be copiously consumed by the crop, it occasions serious exhaustion of the soil, which will not be very readily restored to its former condition; and moreover, that the crop in its full development extracts from the soil a great amount of fertilizing ingredients, which are not supplied by guano.

Those who have had the most extensive experience in the use of guano are unanimous in the opinion that it should be applied only in small quantities, and simply for the benefit of the crop intended to be sown, without any expectation of promoting luxuriance in the following crop.

Referring to the anomalies respecting guano, in this country it is found to be most efficacious when applied in rainy weather, and that it is useless if applied at a dry time, succeeded by a continuance of

dry weather; yet on the arid soils of Peru it has been used for ages, with great success.

The time and mode of applying guano requires attention, and considerably more than is usually devoted to that operation; it should be well incorporated with five or six times its weight of ashes, sand, soil, or salt, and the compost made damp, but not wet, with water, and it should be worked into the land as quickly as possible.

An eminent agriculturist, who is a great advocate for guano, declares that by the application of 2 cwt. which cost £1, he has increased the quantity of wheat to the extent of nine bushels per acre; sown in the autumn with the wheat. Now if this could be carried out universally, there would not be any necessity for importing wheat, but unfortunately there are many impediments. It is estimated that on an average 5,500,000 acres of land are annually under wheat cultivation. If an increase of one quarter could be obtained on the whole, it would amount to the usual quantity imported; but it is unreasonable to suppose that the increase would be so great, except upon good soils highly cultivated; neither could the supply of guano be obtained.

That the effect produced on the land by the continued use of guano year after year, tends to exhaustion of the fertilizing properties of the soil, there can

be no doubt; this has often led to a misconception as to the purity of the guano. It has a decided tendency to weaken the straw of wheat and other cereals, especially when used alone; for this reason, it is recommended to add salt in the proportion of four or five hundred weight to the acre, but this must depend upon the nature of the soil. On clay or wet land salt is prejudicial. In cases of necessity, that is when there is no farm-yard manure available, guano may be applied for wheat, one half at the time of sowing, the other in the spring, in proportion of from one to two hundred weight at each dressing; but it is far preferable to use farm-yard dung, if it can be procured, at the time of sowing, and in the event of the plant not appearing to be sufficiently vigorous in the spring, then to use guano as a top dressing, and hoe it in.

Much of the mildew in the wheat, which has of late years been so prevalent in many counties, may be assigned to the indiscriminate application of guano, and other highly concentrated fertilizers. Mildew proceeds from an over-luxuriant condition of the straw, or more strictly a superabundance of sap arising from too great a proportion of nitrogeneous matter in the soil, as compared with phosphate of lime, or some mineral salt of similar properties. Sometimes proceeding from a superabundance of wet, which carries away

or neutralizes those ingredients. The great art of applying manure consists in introducing or forming an equivalent proportion of every element essential to the full development of the crop to be cultivated, by which means the utmost limits of vegetation may be attained, and which can never be accomplished so long as some of the essential ingredients are deficient. Science has not as yet thoroughly defined this mystery, though earnestly engaged in the important elucidation. But it must be remembered that chemistry, as applied to agriculture, has not been seriously devoted to its interests till within the last fifteen or sixteen years. There is now an enterprising, zealous, and powerful amount of talent working energetically in the good cause, whose labours have already been rewarded by many valuable discoveries, and there is no doubt many more will follow.

The cause of failure in the red clover root, after a repetition of the usual four-course system, although practically known, has not as yet been scientifically explained. That the decay of the plant is the result of deficiency of some nutritive ingredient in the soil of which it has been deprived by a preceding crop, seems to be the general opinion; but it is not yet discovered what element it is that is wanting. It is a remarkable phenomenon. The clover plant, that is the leaves, are said to absorb a great portion of

ammonia from the atmosphere, and it is acknowledged to be an excellent antecedent to wheat, enriching the soil with nutriment for that plant; and yet it is said that when clover is sown after an interval of three years, as is usually practised in the four-course system, with barley or wheat, it is very frequently known to fail the following spring, though the previous autumn a vigorous development of the plant has been displayed. It has, however, been declared, that if in the rotations of crops, grasses of another kind are substituted, the risk of failure is materially diminished. Animal and vegetable life are in many respects capable of comparison. Either must be supplied with varieties of suitable food to bring them to the highest state of perfection. Man cannot bear to subsist upon over-stimulating food, or only one kind of food, neither can plants, and when it is forced upon them disease ensues. In applying manure to land it must be remembered that there is a possibility of overstepping the bounds of propriety; there is a limit to all things, and this is apparent most particularly in the use of artificial manures, in which the elements of vegetation are powerfully concentrated, but at the same time very evanescent.

There is a maximun of produce of every crop, as there is a standard of excellence in animals. A horse, for example, greatly exceeding the stature of

his class, is invariably a worthless creature; nor is gigantic size in cattle, sheep, or pigs accompanied with other important attributes. The earth is only capable of producing certain quantities of grass, grain, or roots, when cultivation has brought it to its maximum; and after this has been accomplished, all the manure that is applied beyond what the crop can consume for its healthy support and development tends to disease or defect of some kind. One half of the fertilizing properties of guano, as determined by analysis, are soluble in water, and therefore available for the immediate requirements of vegetation. If it be applied in excess, the consequences must be readily conceived.

Presuming that the demand for guano in various parts of the globe continues as at present, reports are current that in the course of ten or twelve years the store will be exhausted, unless some discoveries are made of deposits hitherto unknown. Other reports declare that the stock is comparatively inexhaustible. Whether the first have originated in a desire of importers and dealers to keep up the price, I will not hazard an opinion. Without adopting any of the estimates which have been published concerning the stock now remaining, as they contain so many discrepancies and uncertainties, that it is impossible to arrive at any reliable conclusion, too much import-

ance cannot be vested in the discovery of some substance which can be adopted as a substitute.

The depths of the ocean have for ages past supplied manure for the earth; on the western shores of England, and those which bound the counties of Essex, Kent, and Sussex, also the eastern coast of Scotland, where fish is taken in quantities, the refuse is used for manure. In their natural state, the carriage of them to any distance inland is attended with expense beyond their value, the use of them has therefore been confined to districts near the coast, and the supply on the southern and eastern coasts principally consists of sprats. Fish manure certainly does convey an idea, or something more, that if the raw material can be procured in sufficient quantities, and by an inexpensive process be reduced to a convenient state for carriage, a very great desideratum will be accomplished. There is yet another subject worthy of consideration; if the manufacturing of fish manure can be brought into operation, it will be a source of employment to a number of our own countrymen, to whom the remuneration for their labours will be given, rather than transporting enormous sums annually to the treasury of a distant realm for guano. Taking up the argument that guano is the dung from birds which subsist exclusively upon fish, it would seem that the refuse

fish would be identical in its properties, when divested of the water which they contain: but analysis does not verify that fact in every particular, that is as regards the amount of phosphate; nevertheless great fertilizing properties are admitted. It is also discovered that those properties differ in amount in different kinds of fish.

The great demand for artificial manures, and the known advantages derived from the application of fish, have suggested the establishment of manufactories, for the purpose of rendering them convenient for transit. At present there appears to be some difficulty in accomplishing this with a profitable issue, without which it is vain to expect it will be done. Another question exists, whether they can be procured on any of our coasts in sufficient quantities? Taking the ordinary practice of catching fish for consumption as food, as the basis of calculation it is very doubtful; but then it must be observed it is only the choice kinds that are suitable for the table, therefore the means adopted for capturing them are confined as exclusively as possible to those particular sorts, consequently it is only the refuse from them, and fish of inferior kinds, which are accidentally taken in the nets, that have hitherto afforded the means of estimate. But these difficulties may be overcome, as apparently much greater ones have been,

by the ingenuity and enterprise of the present day, when fish manure may be supplied to some extent in augmentation of other fertilizers.

On the south coast of Connecticut in the United States, it is related, that immense quantities of fish are annually taken for the purpose of manure in the month of May. The nets used for this purpose are so large that they will take at once half a million of fish, weighing from one to two pounds each, and it is said that 800,000 have been taken at a single draught; 5,000 of these fish are a cart load, and the farmers usually make a compost of them with turf or peat, and straw.

A manufactory has been established at Newfoundland, and at Concarneau in France within the last three or four years, by Messrs. De Molan and Thurneysen. Concarneau is a small fishing station noted for sardines, situated between L'Orient and Brest, and the population is almost exclusively employed in taking fish. The reports made in 1854 of this establishment are highly favourable, and if success has subsequently attended it, the feasibility of other speculations of a similar kind is corroborated. The process is admirable; it reduces the fish to a dry powder, without altering any of the constituent elements adapted for the nutriment of vegetation.

This is a fact of great importance. All the refuse

of the fish taken at Concarneau and L'Orient is used, including the coarse fish which were, before the establishment of this manufactory, returned into the sea or left on the shore to putrify. The manufactory is capable of producing four tons of fish manure in a perfectly dry state daily, which requires rather more than five times that weight of fresh fish. The fish are submitted to a steaming process, pressed, made into a pulp, dried, and reduced to powder, when they are ready for use. Thus prepared, the weight stands in proportion of 22 per cent. of the fish in a natural state.

These gentlemen have also established a manufactory upon a similar principle at Lowestoft in Suffolk; and another company, called the London and West of Ireland Fishing and Fish Manure Company, has commenced operations. It is to be hoped they will be successful, and meet that patronage their enterprise deserves.

In England a process of making fish guano has been patented by Mr. Pettit. Sulphuric acid is described as the agent used for reducing the raw material to pulp; but chemical analysis assigns to it the effect of reducing the amount of phosphate. The uncertainty as to the quantities of fish that can be taken around our coasts, appears to be an obstacle to the establishment of these very important speculations.

The question of supply is doubtless a very important one; but when it is considered, the immense stores of the finny inhabitants of the deep, frequenting the shores of Great Britain and Ireland, it certainly does appear that the difficulty may be overcome, if steamers of suitable construction, and nets of sufficient size, such as those used at Connecticut, were to be employed.

Progress is the distinguishing system of the day, and forms a striking contrast to the habits and customs of our forefathers. At the commencement of the present century, agriculturists would tolerate no manure that was not tardy in giving forth its nutriment to vegetation, and consequently lasting. It is quite possible to fall into the other extreme. Sir Humphrey Davy recommended bone and horn; the latter in preference, because he said it contained a greater quantity of decomposable animal matter. He further stated that the earthy matter in bones prevented the too rapid decomposition of them. It never entered into his head to render them soluble by the use of sulphuric acid, and in that state quickly available to vegetation. This discovery was reserved to a more recent date, when Baron Liebig introduced it about the year 1840, and from that time the manufacturing of artificial manures has been a source of extensive speculation. Chemistry proclaimed the in-

gredients which were conducive to vegetation, and forthwith enterprising speculators ransacked their brains to devise the most profitable means of collecting all kinds of offal which could be had, containing any part of those valuable materials, which they sold to credulous farmers at a great price. Many of these articles, on being consigned to the earth, instead of promoting luxuriant crops, brought forth disappointment. Hence there are many farmers who are induced to denounce the whole as worthless. That a great number of the so-called fertilizers were impositions, cannot be denied; but yet there are many that are very useful when judiciously applied, and many of the dealers whose characters are untarnished with reproach. Great as the progress has been in the use of artificial manures, the practice may still be considered in its infancy, providing supplies of the raw material can be procured equivalent to the demand.

In the cultivation of turnips of all classes, but especially swedes on light soils, superphosphate is of inestimable value. These roots are so obnoxious to the ravages of the fly, that some invigorating agent is essentially necessary to hasten the growth of the young plant. Nothing hitherto discovered, appears to be equal to superphosphate. Its soluble properties are particularly adapted to the purpose; it is like milk to the sucking calf. But it must be applied in

moderation, not exceeding two hundred-weight to the acre, and the land must be further enriched with a good dressing of farm-yard dung; or if that is not to be had in sufficient quantities, the deficiency may be made good with guano, or some manure containing nitrogenous elements of equivalent amount. In my opinion, farm yard manure is indispensable for the successful cultivation of roots. Complaints were very prevalent in the winter of 1855 and 1856, of swedes and turnips suffering from decay, rotting, in fact, on the first intervention of frost, although they presented a very luxuriant appearance in the autumn. My attention was particularly directed to this, and I traced it to the indiscriminate use of artificial manures. In a report which I supplied for the Mark Lane Express, I alluded to the subject, and singularly enough, Mr. Nesbit's lecture to the Central Farmers' Club, on the relative value of artificial manures, was published, in the same impression, in a great measure, corroborating my observation. Mr. Nesbit said, "From all the experiments which I have made in connection with this subject, it appears to me that in the making of superphosphate of lime, it is necessary to take care not to dissolve all the phosphate. I will tell you what first drew my attention to this point. About 1845 or 46, being on a visit in Hampshire, I rode over a farm in the neighbourhood of Alton. In passing

over a twenty-acre field of turnips, I came to a place where the horse's feet immediately smashed the turnips. All the turnips in that part of the field were perfectly rotten; all the rest were firm and solid; the difference could be seen to a drill. I at once set about ascertaining the cause of this difference.

"It turned out that one part of the field had been manured with superphosphate of lime, and the other with common farm-yard dung and bones. On hearing this, it at once struck me that the cause of this must be, that the superphosphate of lime had been made wholly with soluble phosphate, like coprolite, or apatite, and that when the soluble part had been taken up for the purpose of the plants, the vascular structure of the turnip becoming greatly enlarged, did not subsequently find any material for its further growth in consequence of the other phosphates being insoluble; and the whole system of the turnip being weakened, it fell a prey to the frost which prevailed at that period. Since that time a great many persons have been engaged in making superphosphate of lime, and the use of the article has become widely extended. I may here observe that there has of late been a great loss of turnips, and though I cannot attribute it all to the use of artificial manures, yet I must say that it is in a great degree attributable to the practice of giving a certain amount of phosphate

only soluble, and the remainder insoluble. I dwell upon this the more, because an idea is being diffused by some chemists in favour of making phosphates wholly soluble. Many chemists of the present day have, in fact, recommended that the whole of the phosphates in manure should be made soluble; and I believe that the more this recommendation is adopted the more will turnips be found to rot. I therefore feel it to be a public duty to caution you gentlemen against what I believe to be a mistaken view. I know from my own experience that too much soluble phosphate is very injurious. There should be a certain proportion to get the plant past the fly, but an excessive amount of soluble phosphate cannot fail to do mischief."

The application of bones for the purpose of replenishing the waste of certain elements in the soil, appears, like many other good things, to have been an accidental discovery. Nearly a century ago, it is stated that a Mr. Dobson observed a great increase of wheat on a patch of land near Sheffield, where a heap of bones had lain. The practice was adopted by himself and some of his neighbours, and Colonel St. Leger is reported to have used bones for manuring at Warmsworth, near Doncaster in 1775, five years after the aforementioned discovery; but there is no evidence of the practice becoming at that time gene-

ral. Rather more than twenty years elapsed, when Lord Carlisle resumed the experiment at Castle Howard, near Malton, for which purpose the bones were broken with stampers worked by horse power. In 1804, toothed rollers, similar to those now in use, were applied, by means of water power, to the reduction of bones, by Mr. Jonathan Booth, of Malton. In 1810, Sir Tatton Sykes employed bones, broken with axes, hammers, and such-like implements; but they were not found to give forth their virtues in that state, and those which had been so used, after a few years were gathered off the land, and properly ground by the machinery recently invented. Steam mills were subsequently employed for grinding bones, by Messrs. Darley, at Stocknéth and at Hull, by whom they were sold to farmers in that quarter for manure. Another steam mill was erected at Malton by a son of Mr. Booth in 1823, when the demand for bones rapidly increased. Thus to the enterprise of Yorkshire is the merit due for introducing this valuable agent for replenishing the earth; a material, the benefits of which are diffused through every district of Great Britain. In the cheese-producing county of Chester, when ground and applied to the grass lands, the effects they produced were astonishing. Chemical science has acknowledged the virtues of bones, and practice has confirmed the theory. The following

analysis of Professor Way affords evidence of their properties:

ANALYSIS OF BONES.

Moisture	10
Animal matter	16
Sand	3
Phosphate of lime . . .	60
Carbonate of lime . . .	11
	100

The machinery employed for the reduction of bones crushes them to the size of half an inch, or reduces them to powder; in the former state they are some time developing their goodness, to obviate which the plan proposed by Baron Liebig, of treating them with sulphuric acid, has been very extensively adopted. In the form of powder, as it comes from the mills, it is a more lasting fertilizer than superphosphate, and on that account is to be preferred in all cases except those already mentioned. I am not aware of the plan having been adopted, but I think it would have a good effect if bone dust were employed at the same time with superphosphate. It would compensate for the objections which Mr. Nesbit describes. I believe also that very great advantages would be

derived, if some means could be devised of causing crushed bones to impart their fertilizing properties more quickly when they are in the earth—if some agent could be employed to facilitate their decomposition in the soil, their effects would be more powerful and permanent than in the form of superphosphate. This, however, is a subject for chemistry to define.

The application of salt to the land is of very ancient date; it is mentioned in the 34th and 35th verses of the 14th Chapter of St. Luke. "Salt is good, but if the salt has lost his savour, wherewith shall it be seasoned? It is neither fit for the land nor yet for the dunghill, but men cast it out." Salt must therefore have been used antecedent to that time, and most probably it has continued to be used, more or less, and at intervals, from then to the present period. The duty which was levied on this article most probably restricted the use of it as a manure, so long as that impost continued.

It is said that salt fixes the ammonia in nitrogenous manure; and further experiments will no doubt furnish the public with useful information on this point. Experience proves that in many instances the use of salt is attended with beneficial results, but how it acts is not very conclusively established. It possesses the power of attracting moisture, and in dry seasons, upon dry soils, its effects are conspi-

cuous. Probably it has a power of fixing a greater quantity of ammonia in the soil than would be otherwise held; but it is not adapted for clay soils or those which have a great tendency to moisture. Unadulterated salt consists almost exclusively of two ingredients, chloride and sodium. It is capable of solution in two-and-a-half times its weight of water, and during that process it has the effect of lowering the temperature. Hence it appears that one of the effects produced on the soil by the use of salt will depend greatly on the wet or dry condition of the atmosphere, and that the time occupied in solution will be governed by the state of the weather. In wet seasons grain, especially wheat, is apt to lodge, and salt is recommended by the highest chemical authorities as a preventive. I am not in a position to gainsay the success of the practice, though it seems somewhat anomalous. It serves, however, to prove the unaccountable chemical changes which take place in the soil. Here we have a substance possessing the power, under certain conditions, of attracting moisture and reducing the temperature, and yet it is used for the purpose of counteracting those effects. Most probably the soda supplies the straw with the alkali it requires, and thereby strengthens it. There are many circumstances connected with the practice of agriculture which have not been satisfactorily accounted for by

chemists. Analysis does not in all cases solve doubts. The chemist knows what tests to present to ascertain the presence of certain elements or ingredients; but there are sometimes changes produced in the soil differing from those which are produced in the laboratory, simply because soils often contain ingredients which are not contemplated, and are therefore not sought for in chemical experiments. The study of modern chemistry has proved of inestimable value to the science of medicine, commerce, and the arts; it has also rendered great service to agriculture, but it is capable of affording much more, devoted as it is to the phenomena connected with the cultivation of the earth.

"Who shall decide when doctors disagree?" is an adage significantly applicable in farming operations. The ingredients of which the earth is composed are so numerous, and the works of nature are so abstruse, as to set at defiance in many instances the most scientific researches; many of which are not capable of proof and definition, or, at least, little more than opinions. Then, again, the atmosphere has such a powerful influence over the ingredients of the soils which supply nutriment to vegetation, and the climate of Great Britain is so changeable and uncertain, that the efforts of the most experienced cultivators of the land are sometimes defeated. Compositions, or

fertilizers, which may be highly beneficial during a dry season, sometimes prove injurious if it be a humid one. The properties with which the land is charged, either by its nature, or the manures which have been previously applied, and which are not exhausted, at times oppose difficulties which could only be overcome by elaborate and expensive analysis; and even then it sometimes happens that science is baffled. It seems that the learned in agricultural chemistry are somewhat at issue concerning the true theory of nourishment obtained by different crops from the soil on which they grow. That is to say, the mineral ingredients contained in the plants do not stand in all cases in the same ratio with the elements existing in the soil. In support of this, it is asserted that roots contain but little phosphoric acid, and yet that is fancied to be well adapted to the growth of those crops. Query, Does not the phosphate introduced as a fertilizer in such cases undergo a change, or rather does it not act upon some substance existing naturally in the soil, or on some other manure that is simultaneously applied?

The combination of lime with farm-yard manure has been held by practical farmers of old as an incompatible admixture, and chemistry confirms the doctrine. Lime and decomposed animal substances form ammonia; thus, if that mineral be added to the

manure heap, the ammonia is evolved, after which, from its volatile properties, it quickly escapes. The great difficulty of applying ammoniacal manures to land arises from the waste that takes place. Hence the importance of not permitting an excess of fermentation in dung-heaps. The great desideratum is to introduce those substances which contain the elements of nutriment to vegetation, such as nitrogen in the most quiescent state, and also an agent to convert it into ammonia after it has been applied to the soil when the absorbent properties of that soil will have the power of retaining the greatest possible amount of ammonia, dependant upon the retentive properties of the soil. This is a consideration very commonly neglected, the component elements of fertilizers in their normal state only being subjects of investigation. Professor Way has urged the propriety of applying lime in small quantities annually, or triennially, upon the soundest principles. He says that the addition of lime to a soil sets free half the ammonia it contains; thus acting in the first instance as a stimulant to vegetation, but as an exhauster of the stock of ammonia already in the soil, or to be slowly derived from the atmosphere if applied in large quantities. Professor Way recommends the use of lime periodically at short intervals, not more than eight or ten bushels to the acre. The circumstance of the lime

being an exhauster of the ammonia, is to be met by frequent applications of farm-yard dung.

Lime abounds in most parts of the globe, constituting gigantic mountains and stupendous rocks. It is necessary to animal existence, composing part of the bone, being conveyed into the system in some form or other by the food, in which it is an essential ingredient. The use of lime for agricultural purposes is of long standing, but yet it is doubtful if all its properties are thoroughly known—certainly they are not duly appreciated. In its calcined state, the state in which it is applied to the land, its powers of absorption are great, as it is found to absorb more than twenty-five per cent. of its own weight of moisture. During the process of slaking, it absorbs one-third of its own bulk of water, but in this process a portion of the water escapes in vapour. It possesses a singular property connected with this operation, as cold water reduces it more readily than hot. Although a quantity of water causes it to slake rapidly, it is not essential to that purpose, because, from its affinity for moisture, it will become slaked in course of time, even when placed in a covered building. When exposed to the atmosphere, it imbibes carbonic acid gas, of which it contains more than forty per cent. previously to being burnt. As it increases considerably in bulk by the action of water, and also by its

affinity for the moisture contained in the atmosphere, it is necessary under any circumstances, but especially in the event of rain descending upon it during its transmission from the kiln to the land, to unload the cart or waggon which contains it, otherwise it will have the effect of bursting the sides of the vehicle. General opinion assigns to lime two specific actions, that of disintegrating the soil, and a chemical action on the vegetable matter contained therein. The latter powers are, however, capable of several distinctions, as it renders many substances soluble which are otherwise insoluble, and thus converts inactive matter into vegetable nutriment. This depends also on the condition in which it is applied; for if it has passed its caustic state, that power is materially reduced. Some of the ingredients that are essential to the growth of vegetation are indigenous in the soil, yet constant cultivation exhausts most, if not all, of them; they must therefore be replaced by similar ingredients, or the soil must receive a stimulant which shall have the effect of arousing its dormant properties; for this purpose lime in moderate quantities is a valuable agent in those soils which are not by nature supplied with it.

Leibig ascribes to lime great power on clay soils; he says, "Lime, in combining with the elements of clay, liquifies it, and, what is more remarkable,

liberates the greater part of its alkalies." There is no doubt of its efficacy on clay soils; at the same time, burnt clay, when extensively applied, produces somewhat similar results, and it is more permanent in the mechanical action of disintegration. Admitting Leibig's remark, that lime liquifies the elements of clay, in the course of a short time, unless the process of liming be repeated, the clay reassumes its pristine character of consistency, and that to a greater extent than when burnt clay has been copiously applied. To act efficiently for this purpose, lime must be used in large quantities; and as the advantages derived from the action of lime for other purposes are more satisfactorily obtained by applying it frequently in moderate quantities, the most successful results are realized by using burnt clay for the purpose of disintegrating the soil, and lime to produce the effects which shall now form the subjects of consideration.

When thoroughly slaked, lime becomes reduced to a very fine powder, in which state it affords nutriment to vegetation. It will be seen by reference to the table at page 40, that all the crops commonly cultivated contain a certain portion of this mineral, together with the alkalies potash, soda, silicate, and magnesia, which, according to Leibig, it has the power of liberating from the soil. In a caustic state

it acts advantageously in decomposing animal and vegetable substances being in the soil, and to effect this purpose, it may with great propriety be introduced in moderate quantities at the last ploughing on land that has been previously supplied with farm-yard manure. It is to be remembered that it acts very differently in this way to what it does if added to farm-yard manure in the heap, where, as I have before mentioned, it forms ammonia, to be expended in evaporation; but bringing the two agents in contact in the soil, the ammonia is there formed, the greater part of which the soil has the power of absorbing. This affords an example of what I have in another place alluded to respecting chemical definitions. For the above purpose, only in large quantities lime would prove injurious; from one-and-a half to three tons per acre, according to the quality of the soil, is sufficient. It was the custom of our forefathers to apply abundant dressings of lime at intervals of ten or fifteen years, three, six, or seven tons not being an uncommon allowance on stiff soils. Previously to the general adoption of artificial manures, and the introduction of railways into South Wales, the use of lime was carried to an extraordinary extent. Farmers residing in the highly cultivated districts of England would be incredulous of the customs prevailing in the mountainous parts of the

Principality even at the present time, though they are much improved. It has been the custom to use lime almost exclusively of every other fertilizing agent. The manure made from the stock being very insufficient, and very little attention being devoted to collecting it together in the yards, the common practice was to grow a crop of wheat; succeeding that, one or two crops of oats, by which means, of course, the land became insufferably foul; in that state it was allowed to remain two or three years, till it became a complete mass of couch and weeds, affording no profit beyond that of very slender keep for lean stock and a few sheep. This being limed and ploughed up, was sown with wheat, producing often better crops than an English farmer would contemplate. In these cases the lime acted beneficially, having a vast amount of vegetable fibre to act upon. I have expressed myself in the past tense, because improvements have taken place in Wales, and as railways have diffused the benefits of locomotion, the worthy Cambrians have availed themselves of some of the advantages offered to them; yet in many of the remote parts very little progress has been made in the great march of improvement.

Applied in small quantities, lime is said to increase the absorptive properties of the soil for ammonia. When it is required to act specifically, powerfully,

and quickly upon a bulk of vegetable matter, then larger propertions must be used ; and this will be most perfectly accomplished while it is in the most caustic condition, and if applied during a dry period, the greater will be its power. This, however, cannot in all cases be done. The practical farmer knows that a man may sit down and indite rules, and the results of his observations, and give minute instructions, but the elements and other casualties will not, in all cases, permit of their being put into effect.

On clover lays intended to be sown with wheat, lime may be used with advantage, but the custom of the present day usually substitutes some kind of artificial manure.

After draining land which has long been saturated with water, lime is a very useful and powerful corrector of the vegetable acids with which it is impregnated, rendering that nutritive which was previously injurious. In these soils there is generally an abundance of vegetable matter of a coarse nature. Lime may therefore be employed for three distinct purposes,—to correct the acidity prevailing in wet and marshy land, to decompose the vegetable matter, and to disintegrate the soil.

Lime is of little value on poor, hungry soils, destitute of vegetable matter, unless it has been well dressed with farm-yard manure, which it will have

the effect of decomposing more quickly, and of reducing it to a condition to be readily taken up as food by the ensuing crop.

On calcareous, or limestone soils where it already exists, it is scarcely necessary to observe, that the application of lime is uncalled for.

In the formation of composts, lime is a valuable agent; mixed with soil from hedge-rows, ditches, and in fact all collections containing vegetable matter, it forms an excellent top dressing for grass and seeds. Also, where large quantities of couch are gathered together, lime quickly decomposes it, thus forming an useful manure from a troublesome weed. It is a very general practice to burn the couch, but the benefit produced from the ashes is comparatively trifling: besides which, couch prevails mostly in light soils, which do not derive the same benefit from ashes that heavy soils do.

Since artificial manures have been so extensively patronized, the use of lime has been very materially neglected. For the purposes which have been mentioned, there is no other known substance equally beneficial. Chemical science has recently come to the rescue, and is likely to establish lime in the position that it is worthy of being placed; that of one of the most useful fertilizing agents that agriculturists can employ.

How many years projects have been on foot for the purpose of ridding London of a great nuisance by applying the sewage water to the land, I cannot attempt to state; but I have a curious pamphlet in my possession, written by one Francis Fortune, which he sent to me in the year 1834. This speculating individual observed, "the state of the water in the Thames had been for years the subject of great complaint, but no steps had been taken to remedy it, when for a less sum than the value of the fish to be caught, if clear, or the yearly income from the sale of filth which runs to waste in the Thames, would effectually clear the river and keep it clean." He proposed tunnels on each side of the river, with steam power to disperse the fluid over the land; and described the profits in millions with as much volubility as most men speak of hundreds. It was also to be sent by railroads, then in projection, and millions' worth of corn, hops, cattle, sheep, &c., were to spring up by magic. Like many other projectors of schemes, he had omitted to obtain an estimate of the intrinsic value of the commodity. Nevertheless his plans were not void of interest, and have been for a long period subjects of discussion; and there appears now to be a great probability that means will be adopted of relieving the inhabitants of London from the nuisance, but without appropriating it to the purposes of agri-

culture. The latter plan would be received by many with great satisfaction; it is, however, a problem with which I will not presume to grapple. Great impediments oppose the working of any plan hitherto devised, of conveying the sewage of London, to be made available as a fertilizing agent; and one of the principal objections, so far as I am capable of judging from statements, is, that the manurial properties are not of sufficient value.

The same obstacles, however, do not interfere with the use of liquid manures made in connection with the farm, although some doubts exist as to what is the most effective and profitable means of employing them.

Upon the principle that the food of plants is received in a state of solution, the application of manure in a liquid form appears reasonable. Some agriculturists, going into an extreme, have adopted the plan of keeping their stock on boarded floors without straw to lie upon; and have the dung and urine mixed with water, and conveyed to the land by means of pipes. My humble capacity for improvement may be stigmatized as limited, but I cannot acknowledge any system to be an improvement, against which there are many obvious objections. One of these I hold to be, that of not supplying the stock with comfortable beds of straw; without which their thriving proper-

tics are impaired. It is fallacious reasoning to estimate any increased value of crops of grain or roots, if in producing those crops the value of the stock is deteriorated beyond the increased worth of the crops. For cereals and roots, liquid manure is not equal to that which is in a solid state, though well adapted to grasses, clover, and lucern.

Contemplating the valuable fertilizing properties contained in the liquid manure that flows from a vast number of farm-yards throughout the kingdom, it occasions a feeling of wonder that farmers, individually, are not more alive to their own interest, and that tanks or reservoirs are not universally provided for its reception, in order that it may be applied to the nearest fields, either by gravitation, steam power, or water carts; not as a general system to the exclusion of solid manure, but upon the principle that nothing of value should be wasted. The means of distributing it must depend upon locality, and the appliancy of steam power. The liquid manure drills, recently invented, are valuable auxiliaries.

When it happens that there is an abundance of couch and weeds, and a tank is constructed for the reception of the liquid manure, an excellent compost can be formed by carting the aforesaid couch to the vicinity of the tank, and pumping the liquid upon the heap, repeating that process as often as may be found

necessary. The mass will absorb the valuable properties of the liquid, which, added to the decomposed vegetable matter, becomes an excellent manure. When this is not available, every atom of refuse matter within a reasonable distance may be formed into good manure by a similar process.

Where the system is adopted of keeping the stock constantly in covered homesteads or yards, the application of liquid manure is of the utmost importance; in fact, it should be considered as an identical feature of that system. In these cases it is generally applied to the grasses as they are mowed; but a showery time should be chosen for the purpose. If this cannot be accomplished, the operation must be performed at night when there is dew on the grass; for if it is used when the sun has influence, a film is formed which is very injurious. Not attending to this, many persons have been disappointed with the results, and have abandoned the project.

Considering the powers which charcoal possesses of absorbing ammonia and other gases, it would be naturally inferred that it may be employed as a valuable agent for collecting those important ingredients and applying them to the land. In a dry state charcoal absorbs all the gaseous forms, and with this view it has been used ground to a coarse powder and strewn over farm-yards and manure heaps with

the expectation that it would collect the gases as they are formed. Charcoal produced from peat has therefore been suggested; and when it is remembered the vast extent of these formations which are found in Ireland, Wales, and some parts of England, if it could be rendered available it would certainly prove of inestimable value to agriculture. But Professor Way confutes the practice. "He doubts whether peat charcoal could be used economically for the purpose of soaking up tank water; if not, he feared it would prove of no advantage in other respects as a remunerative agent to the farmer. It has been long before the public, but has not progressed in market value, as it would have done had its application been successful. He considers it to lead to much error in practice, that the exact nature of the action of charcoal on ammonia was not better understood by the public. Fresh-burnt charcoal would absorb a large quantity of ammoniacal gas, but it was a mistake to suppose that it would consequently abstract ammonia from a liquid impregnated with it; on the contrary, water had the power of displacing from charcoal the whole of the ammonia it had received in a gaseous state within its pores."

It is to such investigations as these, that the agricultural public are deeply indebted to chemical science; from whence they not only receive very

valuable hints concerning the combinations which are calculated to improve the soil, but they receive cautions which prevent them falling into errors.

When all the probable sources are ransacked from whence fertilizers of the earth can be obtained, it is remarkable that peat, or bog earth, cannot be converted to some useful purpose. It consists of vegetable matter, partially decomposed, but in that respect varying in different deposits. Chemistry would confer a valuable boon to agriculture, by the discovery of some process by which peat could be appropriated as food for vegetation.

In the application of artificial manures, it is of the first importance to make a selection which will be suitable not only to the nature of the land, and the fertilizing properties it contains, but also to the crop. Neglecting this, money is often expended uselessly. For wheat a top dressing of guano, in the spring, if the land is not sufficiently enriched with manure from the farm yard, is a practice previously recommended. Wheat contains a considerable portion of gluten, for the formation of which it requires much nitrogen. Soot is likewise a good material for top dressing. The growth of turnips will be more successfully promoted by the use of super-phosphate. Before super-phosphate was introduced, I have seen good effects produced by lime, a much-neglected

mineral, but which I am inclined to believe will again be restored to favour. That lime is a valuable agent, where there is an abundance of vegetable matter in the soil, is a lesson that I learnt in early life; I was then residing in Shropshire with an elderly relative, who farmed rather extensively on old-fashioned principles. An old diary serves to refresh my memory of the circumstance. A field of strongish loam was limed and sown with turnips. The only conceptions that entered my head were guided by custom, and I expressed to the bailiff my opinion, that as the land was foul, it would be more consistent to clean it for wheat, and that lime was not a suitable application for turnips. His reply was to the effect that they would not have the required quantity of turnips if that field were not sown, that they had no farmyard manure for it, and that lime was better than nothing. The result was a very fair crop of turnips. I do not introduce this as an example of good farming, but merely as far as it goes in recommendation of the use of lime. Many complaints have prevailed of late years of the failure of turnips, on the first appearance of frost. Exceptions may be traced where lime has been used for a previous crop, but as that mineral has gone so much out of date with the leading farmers, those circumstances are generally overlooked.

Experiments have been made, but more are wanting, on the effects of various fertilizers to be used in combination. These, however, could only be satisfactorily performed under the superintendence of chemical knowledge. A person unacquainted with the science would be very likely to fall into great mistakes by sing incompatible ingredients. He would be like a quack doctor, who prescribes medicines without having studied chemistry.

There is no doubt that artificial manures are of great value in certain cases when judiciously applied; but whether the fashion of the day will not lead to injurious results, occasioning serious exhaustion of the soil, and disease in the crops, if persevered with, remains for future proof. If the farmer neglects his best friend, the farmyard dung-heap, this land will assuredly rebuke him for his inconstancy; if he adopts a mistaken mode of calculation, and comes to the conclusion, that artificial manures can be purchased at a lower cost than farmyard dung can be made, he will eventually find reproof in his exchequer.

Artificial manures, and the rotation of crops, are intimately associated. Much discussion has recently taken place respecting the rotation of crops. Those who advocate a change, urge that the use of artificial manures justifies an alteration in the four-course

system. Likewise it is argued that the land has become tired or sick of producing certain crops, turnips, and red clover, for example, at such short intervals. The failure of red clover has already been referred to without the cause being satisfactorily established. But it is not a new feature in agriculture, for I can remember many instances of similar occurence thirty years ago, on farms where the four-course system was not closely adhered to. If the red clover fails under the four-course system, or any other rotation of crops, and it proceeds according to the conclusion from a deficiency of some nutritive ingredient in the soil, it is quite evident that the artificial manures that have been introduced do not supply the nutriment required, and some other application is necessary. Would not the deficient nutriment be supplied by the use of lime in compost with vegetable matter, or earth, as previously recommended? to be used as a top dressing. In bygone days, when lime was more in fashion, I have known it applied in that manner to clover and seeds, with the best results.

Depasturing stock upon red clover during frosty weather is a most baneful practice: if there be only a nocturnal white frost in the autumn, and sheep are on the land, the clover is certain to sustain much injury.

The failure of turnips has also been touched upon, and Mr. Nesbit's very rational explanation given. The failure of that crop, or rather the incapacity of the root to withstand frost, is clearly traced to the indiscriminate applications of artificial manures. Dwelling upon the theory that "ammonia and phosphate are two of the most essential elements required for the nourishment of plants," I am strongly impressed with the conviction that those ingredients almost exclusively have occupied the attention of the numerous manufacturers, and of those who have so extensively patronized them.

This leads to a brief digression on the customary rotations of crops in some districts; though the intention and limits of this little volume will not permit of a lengthened discussion on the much-vexed question of tenant right. In many cases the articles of tenancy prescribe rules for the cultivation of the soil, and including the rotation of crops, which are probably opposed to the best interests of landlords, tenants, and collaterally of the public. The restrictions in the first instance were introduced by landlords, to prevent avaricious tenants from reducing the value of the estates, and were most probably framed by gentlemen of the law, possessing more intimate acquaintance with legal than agricultural practice.

That restrictions, as they are commonly enforced,

restrain the liberal farmer from the free exercise of his skill and capital, to the prejudice of the landlord and himself, there is no doubt, and where there is mutual confidence, they are relaxed with great advantage to both. As a principle, it is but reasonable that there should be some conditions calculated to restrain covetous and sometimes inexperienced persons from devastating the land which they cultivate. Farmers characteristically are the most honourable class of men in the British dominions. When men of other grades, professions, and callings are constantly failing, and perpetrating deeds the most disgraceful, recklessly speculating far beyond their means, defrauding creditors, and disgracing the name of their country,—for the honour of the farmer, no such delinquencies have ever been charged against one of his community. During several years agriculture was anything but a remunerative speculation—in fact, it was a losing one—but those who were engaged in it bore their losses with becoming, manly fortitude. They reduced their expenditures within the limits of their resources, and thus overcame their difficulties. Fortune smiled upon them, times improved, and they have reaped golden harvests, not only of crops, but in the estimation of their fellow men, a just reward of philosophy and integrity. Still it is necessary that some form should exist to restrain persons from wilfully dete-

riorating the land they till, as much as it is necessary to restrain others from demolishing the houses they occupy. If a tradesmen takes a shop in London, and makes alterations for the especial purposes of his business, he is required, when he quits the premises, to leave them in the same condition as he found them—and this should be the case with land. The position of a landed proprietor is to be consulted as much as that of the cultivators of the soil. He may have twenty tenants in whom he can justifiably repose the utmost confidence, over whom he would not wish to exercise the slightest restrictions; and he may have four or five who would impoverish his land if they were not bound by some covenant—moreover, it would be inconsistent to impose conditions over the few which were not applicable to the whole—it would engender discontent and jealousy. There are many landlords who do not devote much attention to agricultural pursuits; those who do, are less disposed to introduce strict, much less unprofitable, conditions in their agreements. An Act of Parliament containing a few simple clauses, not as to any precise course of crops or cultivation, but merely restraining tenants from diminishing the value of property, yet giving them a claim for permanent improvements in the way of buildings, or power to remove them, if they have found it necessary to erect them for the convenience

of their occupations, would, I feel confident, place landlords and tenants upon better terms of confidence and security.

The most advantageous rotation of crops depends so much on the quality of the soil and locality, that no general rule can with propriety be fixed; and in some cases the soil differs so essentially on the same farm, that a course which is well adapted for some fields is inconsistent for others. On light turnip and barley soils it can scarcely be profitable to sow barley after any preparation but roots—mangold, or turnips of some kind; but when the staple is stronger, the land perfectly clean, and in a high state of cultivation, it may be desirable to grow a crop of wheat after the turnips, and let barley follow; it will not be so likely to become lodged, and the sample will be finer; but where there is one farm in such condition that this practice can be adopted with advantage, there are twenty on which it cannot.

In connection with draining and manuring, the perfect and deep cultivation of the soil, especially when in preparation for root crops, is of the greatest importance. I have in another part introduced the subject of evaporation, in aid of which, deep cultivation—to promote also the aëration—of the soil is imperative. The numerous implements that have of late years been invented for this purpose leave no

excuse for imperfect tillage; and it may be reasonably hoped that steam-power will ere long contribute its gigantic agency in facilitating these operations.

The most suitable season for the application of manures is a subject which must not be neglected; so much of its efficacy depends upon that. The weather must be consulted, for nothing can be more improper than trampling on the land when in a wet state—when it poaches, as it is termed. For turnips or mangold it is highly desirable that the wheat stubble be cleaned with a scarifier as soon as possible after harvest; and when that is accomplished the farmyard dung may be applied, and immediately ploughed in. It requires moisture for its decomposition, and perfect amalgamation with the soil, which will take place during the succeeding winter. If deferred till after that period, it should be done as early as possible in the spring; and when the turnips are sown, a dressing of super-phosphate will accelerate their growth, and materially prevent the ravages of the fly. If the manuring is deferred till the time of sowing the turnips, two very important objections are attendant. The manure cherishes the fly, and when the manure and the land are both in a very dry condition, much of the goodness contained in the manure escapes.

The earth may be compared to a wealthy patriarch

with a large family of emulous sons, who are continually making appeals to his exchequer, till at length he becomes crusty, and refuses the supplies except to those whose assiduity, skill, and perseverance proclaim their title to his benevolence; and to them his liberality is unbounded.

CATTLE.

Any attempts to ascertain the character of the primitive race of cattle would be more amusing than profitable or instructive, as all researches would at last be inconclusive, there not being any traces in history to confirm theories. This is unfortunate, as it would have afforded rules by which to determine the properties imperative for the attainment of perfection in a state of nature. Noah was commanded to preserve every beast of the field, but no description is given of their respective characteristics. That the different classes of the animal creation were at first perfect, as relates to their natural wants and necessities, there can be no doubt; but the comparatively wild condition of the domesticated animals, and the rude state of agriculture for many generations, have contributed to their degeneracy. The effect of climate also has in some instances changed so completely the characters of animals, that naturalists have imagined members of the same families belonged to a distinct race. This is generally defined by the fact, that however different

the appearance of individuals of the same species may be, they will breed together, and their issue will be productive. Not but what there are hybrids, but it is rare that examples are found of those hybrids producing any offspring. The mule, the offspring of the horse and ass, serves for an illustration.

In England, by referring back little more than two centuries, it is found that agriculture was in a very barbarous condition; there were few, if any enclosures, and cattle when ranging in their pastures in this wild state must have bred promiscuously; indeed at the present time this is very much the case in the mountainous districts of Wales. If pure breeds were originally introduced into this country—and concerning the purity of the first introductions we have no authority—it would be ridiculous to suppose that under such circumstances they would have continued in a state of purity, though it has been attempted to be shown that they were distinguished or classified as long-horns, middle-horns, such as Herefords and Devons, and polled, or those without horns. The effects produced on animals by food and climate have been long known and acknowledged by naturalists, and all others who have devoted attention to the subject. This brief review is sufficient to account for the uncertainty of character which predominated for a very long period among the cattle of Great

Britain; and although there can be no doubt that the influence of climate produced certain distinctions, yet it was left to the enterprising and improving spirit of agriculturists and graziers to divide them into specific classes.

The first attempt of which there is any authority towards this very important step in improving the breed of cattle, was made about a century ago, by Sir Thomas Gresley, of Drakelow House, near Burton-upon-Trent; Mr. Bakewell, of Dishley; Mr. Webster, of Canley; Mr. Fowler, of Rollright; Mr. Princep, of Croxal, and a few others; but to Mr. Bakewell's memory is the honour due of having adopted the most successful course. This was with the long-horned variety then common in the midland counties. Mr. Bakewell's object appeared to be that of rearing cattle for grazing; and this he accomplished by selecting animals to breed from combining the necessary qualities, and breeding in and in to a considerable extent. This breed was held in great esteem during the latter part of the past, and commencement of the present century. High prices were obtained for superior animals of both sexes; and although the long-horns have comparatively gone out of fashion, some animals of great merit have been exhibited at Birmingham of late years, by Mr. Burbary, of Wroxhall, and Captain Inge, of Thorpe. The original

long-horns are described as having been coarse, large-boned animals, moderate milkers, and not possessing great aptitude to fatten; but these were, no doubt, prevailing faults with all the stock of olden times.

Whether instigated by a spirit of rivalry, an impression that the long-horns were to be supplanted, or from what particular cause I cannot explain, but no sooner had that breed been brought to a state of considerable perfection by Mr. Bakewell and his cotemporaries, than a desire of competition arose in the north. Mr. Collings, of Ketton, near Darlington, in the county of Durham, was aware of the excellence of the breeds of cattle common to the borders of that county and Yorkshire, called the Teeswater, those of the Holderness district in Yorkshire, and others in Lincolnshire. He had heard also of the fame of the long-horns; and in early life he paid Mr. Bakewell a visit, from whom he learnt the proper form of cattle and sheep, the models of which he carried in his eye. The breeds already named were chosen as the origin of an improved race, and the celebrated bull, Hubback, was bought by Mr. Collings and his brother, in 1777, when a calf. The fame of this herd spread rapidly by the production of an extraordinary animal of the day, a descendant of Hubback, known as the Durham ox, and also by a bull called Comet, which was bred by the Messrs. Collings, and sold by auction

for 1,000 guineas. Messrs. Collings adopted the system of breeding in and in to a considerable extent, which for a time was not productive of injurious results; but it is an outrage upon nature which cannot fail, when carried to excess, of producing baneful consequences. Perceiving the evil in want of stamina and the faculty of reproduction, they adopted the rash experiment of introducing a Galloway bull to some of their best and most valuable cows. It is truly wonderful what errors the most sensible and talented men will sometimes commit—what excesses they will perpetrate. Up to this period they had kept to one description of animal, they had been breeding from stock of a similar character, and had they sought for change of blood from similar classes there is no doubt they would have been perfectly successful, instead of rushing into such an extreme by seeking a cross from an animal so essentially different in all its properties. This could not be washed away for several generations, and the most scrupulous breeders of the present day repudiate all the descendants inheriting that stain.

From the time of the Collings' and their cotemporaries, the late Earl Spencer, Mr. Foljambe, and others having brought the short-horns into repute; they have been the pet stock of the most fashionable breeders, including noblemen and gentlemen of un-

bounded wealth, liberality, and zeal. The names of the Marquis of Exeter, the late Earl Ducie, Earl Spencer, Sir Charles Knightley, Colonel Townley, the late Mr. Bates, Mr. Stratton, Mr. Tanqueray, Mr. Wilkinson, and hosts besides, are sufficient guarantee for this. Under such fostering patronage they could scarcely fail to arrive at great perfection, for certain purposes; but whether extremes have not been introduced which render them less valuable in point of general utility when impartially investigated, must be a subject for future consideration.

The origin of the Herefords is not accurately known, though it is related that they were imported from Flanders some two centuries ago. Whether there is any truth in this I will not presume to offer an opinion, or whether the report originated in the circumstance that cattle of a similar description are depicted in old Flemish paintings. This at least confirms that they had in Flanders cattle similar in appearance. From what cause it is difficult to explain, this breed has not hitherto received equal attention and patronage that the short-horns have enjoyed. In the county from whence the title is derived, and in the adjoining counties of Salop, Worcester, and Radnor, this breed flourishes most conspicuously upon its own real merits. It has for many years been held in the highest esteem, and although the banners

of fashion have not waved over it so extensively as the short-horns, some of the best judges give it precedence. The splendid animals which have of late years been exhibited at different agricultural meetings by Lord Berwick, of Cronkhill, near Shrewsbury; Mr. Walter Maybery, of Brecon; Mr. Carter, of Doddington, near Ludlow; Mr. Price, of Pembridge; Mr. Daniel Burnett, of Turnstone, near Hereford; Mr. W. Racster, of Thringhill, Hereford; Mr. Samuel Walker, of Urwick, near Ludlow; Mr. Tudge, of Ashford, and many other gentlemen and farmers, have maintained for this excellent breed of cattle the high repute that it justly merits. It may be here remarked, that when prizes have been given at agricultural exhibitions for the best animals in any of the classes of short-horns, Herefords, and Devons, that the Herefords have had their share of awards; and in some instances, when preferences have been given to the short-horns by the judges, public opinion has reversed the decisions.

Irrespective of the Herefords which are exhibited at the meetings, it is impossible to enter the county, or the adjoining counties, where the breed is prevalent, without being forcibly impressed with the general excellence of the common stock. Of course, some indifferent animals may be seen, but they belong to small farmers and persons who do not possess the

taste or judgment to make better selections. If it were possible to inculcate in the minds of such persons the difference in point of value, and the consequent profit between good and inferior animals, it would be the readiest and most certain step towards universal improvement in their stock, and in the cultivation of their farms; but until a more liberal and generally diffused system of education be introduced among that class, those great objects will never be accomplished. It may be accepted almost as a rule that the more enlightened a man is, the more refined will he be in the selection of his stock and the cultivation of his farm.

The Devonians have just cause to be proud of their cattle; they are decidedly the handsomest of the English breeds. The symmetry of a high-bred Devon is exquisite. The small muzzle, the beautifully light head, and good-tempered countenance, the graceful horns, the level back, the deep chest, the springing ribs, the short and fine legs, and the slender tail, alike pourtray the purity of the breed and the beauty of the bovine family. The richness of colour also adds greatly to their appearance. The antiquity of the breed is another claim to distinction. They have for many years held a distinguished rank at the exhibitions, and maintained their pride of place with their more bulky cotemporaries, the short-horns and

Herefords. They are evidently well adapted for the hilly country and the mild climate of the west of England. It is a general principle, that all animals bred on the hills are smaller in stature than those which are bred in the valleys. This applies alike to cattle, sheep, horses, and dogs. The celebrated Mr. Coke, of Holkham, afterwards Earl of Leicester, is said to have given preference to the Devons before the short-horns, after giving an impartial trial to both.

These three are the only breeds of cattle that are recognised as pure, or, adopting the language of the turf, thorough bred. It is here necessary to inquire what constitutes the title? It might be argued that there is in reality no such thing as pure blood among any of our domesticated animals, unless the principle is adopted that by keeping to one particular strain for a given number of generations the breed becomes pure. Hitherto the precise number of generations required for this purpose has never been defined. The lapse of time has cast a shroud of obscurity over the originals of the race-horse as well as those of the bovine family. This is apparent in the pedigree of Eclipse. His male progenitors may be traced to one of the royal mares imported by Charles the Second, but the aristocracy of the female lineage is not confirmed beyond the third generation. When we get

as far back as the early part of the seventeenth century, the pedigree of horses can scarcely ever be traced in the mares, although on the sires they extend to longer dates. The same obscurity prevails in the pedigrees of cattle. If it were not for the Stud-Book of Messrs. Weatherby, and the Herd-Book of Mr. Coates, breeders of horses and high-bred cattle would continue to grovel in the darkness of our ancestors. These researches confirm the previous allusion, that in olden times there was no pure breed of animals in the equine or bovine families cultivated in Great Britain.

This leads to the inquiry, what ought to entitle an animal to be classed as pure bred? It is an accepted distinction, and requires to be defined. It may be adopted as a principle, that breeding from animals possessing similar characters for a certain number of generations establishes a title to purity of blood. Out of this issues another query. How many generations will it take to obliterate the impurity? Arithmetical progression will serve to throw some light upon this. Supposing a cross-bred cow to be put to a pure-bred bull, the issue will only inherit half of impurity. That issue being again put to a pure-bred sire, will produce an offspring with only a quarter of contamination; and carrying on this process to the tenth generation, it will be reduced to $\frac{1}{1024}$. I think it

may be fairly accepted that the tenth generation might be acknowledged as thorough-bred. If a principle were to be introduced under the sanction of the authorities by recognising a practice, it would have the effect of clearing up all doubts; and if it be thought expedient to restrict the qualification two or three generations further, the contamination would be almost infinitesimal.

The motive for patronising pure breeds of animals is important. The advantages which arise are diffused throughout the country in various ways. The effect is that of producing races which shall possess the highest perfections for specific purposes. As a pursuit it is most interesting, for it requires combinations of talent, judgment, study, extensive experience, and much perseverance. Many have made the attempt without gaining fame or profit, ostensibly because they have entered into the engagement without studying sufficiently the principles and the laws of nature. The proper conception of the qualities which an animal ought to possess, simple as it may appear to be, is an attainment which very many can never accomplish. Besides, a man may be an excellent judge of one kind of animal and not of another. Superior judgment on these points is, in fact, a gift. Perseverance and practice will surmount many difficulties, but unless a man can carry the model well in

his eye, he never can become a first-rate judge of animals.

To breed superior stock, it is necessary to investigate and compare the properties, tempers, and constitution of every animal, so that any imperfections in one parent may be in those particulars remedied by the excellences of the other. The peculiarities of ancestors should likewise be taken into similar account. The disposition to "throw back," as it is termed, prevails with all animals, but it is most conspicuous in animals of contaminated pedigrees.

To understand the advantages which have arisen from the improvement that has been effected of late years in the pure breeds of cattle, it is necessary to observe, that five-and-twenty years ago an ox was not considered to have attained sufficient maturity to commence feeding for the butcher till he had passed beyond his third year, when, after that, nine or ten months were occupied in making him fat. It was also very customary, in order to turn him to the most profitable account, or at least with a view to that end, to work the ox on the farm till he had reached his fifth year. This practice, it is almost needless to remark, is now obsolete. The early maturity for which the pure breeds are famed, allow the grazier the advantage of a year in getting his stock ready for the butcher. This has been accom-

plished by breeding from animals somewhat nearly related, carefully selecting those of precocious natures and aptitude to fatten, and in supplying them from their birth with nutritious food. These qualities have been dispensed to a certain degree among the local breeds of various districts, by crossing them more or less with bulls of pure breeds, and thus entailing on the progeny a portion of the perfections of their sires. Had it not been for this march of improvement in the management of stock to meet the exigencies of our increasing population, the supplies ere this would have run very short.

Animals in a wild state are no doubt, in some cases, the offspring of incestuous intercourse, and as it seems to be permitted by Nature, it may be supposed to entail some good properties. In the establishment, so to speak, of what is termed a pure breed both of horses and cattle, it has been a general practice; and so long as there are but few animals of similar character, it appears to be almost an inevitable procedure; but when future generations have extended the family, very near approaches to consanguinity may be avoided. The most prominent effects produced by breeding in and in are delicacy of constitution and frame, precocity, and placidity of temper, and from these are derived some of the qualities which are valuable in cattle and sheep. Delicacy of constitution

and frame as substitutes for the big bones, flat sides, high legs, and gaunt frames, often seen in animals of unthrifty natures, are acquirements, if judiciously promoted, which tend to the perfection of the breed: but this must ever be remembered, that an extreme of delicacy of constitution leads to degeneracy, debility, and impotence. Precocity is an attribute that can scarcely be carried to excess by in and in breeding; because, if the constitution be materially enfeebled by that cause, the early development of the frame will surely be retarded. A placid temper, bordering on constitutional lethargy, is highly conducive to a tendency to accumulate fat. With these views breeders have carried on the system to a very great extent. Mr. Collings discovered that breeding in and in, if carried to excess, was attended with mischievous results; and although it might be supposed that his experience in cultivating the short-horn race would have acted as a beacon to warn others of the danger, the "Herd Book" affords unmistakeable evidence how very nearly some of the celebrities of the short-horn family are connected. The "Herd Book," however, merely displays the lineage, and other testimony must be given concerning the qualities of individuals. Having had opportunities of observing the properties of some of the short-horn family of a very celebrated herd, which were very closely bred, I can state with

perfect confidence, that debility of constitution, amounting to extreme delicacy, and impotence in the males and barenness in the females, were their characteristic failings. Consanguinity in cattle, by the union of second cousins, or perhaps, in some cases, of first cousins, may be admitted with advantage, but nearer relationships must lead to injurious results.

When the long-horns went out of favour, as they did, about the commencement of the present century, the Herefords took the lead more upon their own merits, than upon any extraordinary exertions made by breeders to establish and maintain their fame. This speaks highly in favour of Herefords. The extraordinary exertions and enormous sums of money that have been bestowed on the short-horns, to bring them to the state of perfection at which they have now arrived, exceeds materially that which has been bestowed either on Herefords or Devons. Fashion has exercised a great influence in this respect, as she does on most other occasions. Foreigners from all countries have freely purchased short-horn Devons and Herefords at good prices, giving, in some instances, enormous sums for the former. The reports from America afford much interesting information, as the three breeds have each their partisans; and with the enthusiasm characteristic of their native land, the champions of each proclaim their excellences with

unbounded warmth. It appears in the New world as in the Old, that the merits of each breed are pretty equally balanced, fashion in both cases proclaiming for the short-horns. When we read that short-horns are exhibited at the American Agricultural Meetings, protected with clothing, and that the other breeds are not, it certainly conveys the idea that their constitutions are more delicate.

The property of producing butchers'-meat of the best quality, at the earliest age, has been the principal object with breeders of the pure races of cattle, or in other words, a disposition to fatten. To this the production of milk has been sacrificed; for although it is found that the best quality of milk and the best quality of flesh may be combined in one animal, or, as a general principle, in one breed, yet the greatest amount of flesh-producing properties, and the greatest amount of milk-producing properties, cannot be combined in the same animals. The primitive race from which the short-horns were produced, were, according to the authories of that day, celebrated as good milkers. The pure-bred animals of that class have completely lost the property of first-rate milkers, by the efforts made to substitute the propensity to feed. The Herefords and Devons stand in a similar position, but, perhaps, not quite to so great an extent. With regard to the principle, that the best quality of milk,

and the best quality of flesh may be combined in one animal, and that milk has been sacrificed to substitute flesh, by selecting animals to procreate their species evincing the greatest aptitude to fatten, and also by supplying them with food calculated for the purpose from generation to generation, till the qualities became an inheritance, by similar treatment, only reversing the selections, that is to say, by choosing those to breed from which are the best milkers, and supplying them with milk producing nutriment, a breed might be established as highly celebrated for milking properties as the present breeds are for feeding. It is a subject which, I think, demands some consideration; for highly as the property to feed has been improved by the pure breeds, the property of milking has not been cultivated in any of the common breeds. To promote success in the breeding of domestic animals, let the kind be what it may, experience has demonstrated that it is necessary that the male progenitor be of a pure breed. The pure breeds of Herefords, Devons, and short-horns, have proved of incalculable service, by infusing into the common breeds a propensity to fatten; but the hiatus is visible in the rural economy of Great Britain, which requires to be supplied with a breed of cattle most exclusively adapted for the dairy.

The various kinds of cattle which are dispersed

throughout different parts of Great Britain, cannot be identified beyond their association with the districts to which they are peculiar; those peculiarities being, to a very great extent, the effect of climate. The Kyloes, and the Ayrshires of Scotland claim distinction, as approximating to a pure breed, and the former stand preeminent, when made fat, for the superior quality of their meat. This is due to the mountainous country in which they are reared; for with all animals, from the ox to the rabbit, the flesh of those which inhabit the higher regions will always be found of a more delicate texture than of those which are the denizens of lower altitudes. The food is sweeter and the air more pure on the hills than in the vales. In every species of living creature it is found that those which are acclimatised to the mountains and the hills, although lower in stature, and smaller in size, are more active, more wiry, and finer in the bone than those which enjoy the luxuriant fare of the vales. A mountaineer may be removed from his native wilds to the vales with advantage, and the Kyloes require that change to make them fat. Early maturity is a quality which the Kyloes are not considered to possess, and that to any material degree seems to be almost incompatible with their natures. Roaming freely over their mountain pastures, it appears to be impracticable to superinduce any great

amount of precocity, and keeping them in a mere artificial state, in order to produce it, would effect so great a change in their constitutions as to deprive them to a considerable extent of the superiority for which they are famed. Crossing them with the pure breeds in which early maturity is established, could scarcely be expected to result in success, as the climate and food to which these breeds are accustomed, and the artificial treatment to which they have been more or less subjected, would not be suitable to their natures, and the offspring would degenerate. If any cross would answer, I think it would succeed best with the Devons, as being more nearly assimilated with the Kyloes in symmetry, proportion, and habits, each being inhabitants of hilly countries, though the temperature of the two districts is essentially different; and that appears to be the great impediment.

The cows of Ayrshire have long been celebrated for their milking properties, and it seems very probable they have an infusion of the old Durham or short-horn blood. Without ever having arrived at the distinction of a pure race, much attention has been devoted to them, and with their good milking properties they combine a fair aptitude to fatten. It is not improbable, with judicious management, they might be an eligible source from which could be established a valuable pure-bred stock for dairy purposes.

The cattle of Pembrokeshire, which are dispersed throughout a considerable portion of South Wales, are somewhat similar to the Kyloes, but possessiug earlier maturity, a faculty very materially, if not entirely, the result of climate. In size they are nearly the same, the Pembrokeshires having rather the advantage, and the meat of either is held in about equal esteem by the butchers who supply the epicurean tastes of the metropolis. In colour too they are alike, most of them being black. The white face of the Hereford is often seen in Pembrokeshire, but that is the issue of a cross. Indeed some of the most enterprising breeders in Pembrokeshire, and other parts of South Wales, have introduced Herefords with great success, that very superior breed being particularly adapted to the country.

The county of Sussex claims notice for a variety very much resembling the Devons, similar in colour, but heavier, and not possessing that appearance of aristocratic breeding so pleasing in the Devon, but with which many have evidently been crossed. A desire has been expressed by some of the most eminent breeders in the country that they should be identified as a pure breed, and prizes offered for them as a class at the agricultural exhibitions. The subject has already been referred to at page 127 as

to what ought to constitute the title to purity of blood; in other words, how many generations will it take to obliterate the impurity. An example might be established from the short-horns, by calculating how many generations had passed since the time of Hubback, to the date when short-horns were acknowledged as a pure breed.

To attempt to trace, or even to describe, the varieties of cattle that are to be found in different parts of Great Britain would be an endless and an unprofitable task, so many intermixtures have taken place. It is only in those districts where breeding for the butcher is the custom, that any thing assimilating to a standard or class is to be recognized; and even in those parts, many varieties will be found, originating in the difference of opinion existing among breeders. In the dairy countries good milkers are the principal object of attention. If a cow be a good milker, no consideration is ever devoted to her breed; if her produce be a female, it is reared; if a male, it is sold to the butcher. Unfortunately there are no bulls of a race distinguished for milking properties, and the only alternative the dairy farmer has, is that of breeding from a bull descended perhaps from a cow that was a good milker, but of mongrel origin, a custom attended with much uncertainty; or if he procures a bull of a pure breed, he

generally entails on his progeny a greater disposition to fatten than produce milk. A breed of very superior milkers might be produced, without running into so great an extreme that no reasonable amount of food would render them fat, as with the Alderneys, which are by no means calculated for a dairy farm where profit is the object.

In making choice of either of the pure breeds, the successful issue will depend materially on locality. It is well known that climate exercises a very powerful effect on all our domestic animals, and although artificial treatment will to some extent obviate this, it will not entirely overcome it. I certainly should not select short-horns for a hilly, bleak, mountainous district. Not that I am prepared to denounce them as a breed as some have done, that they are extremely delicate, hot-house productions: an impression that, no doubt, has arisen from peculiar circumstances. It may happen, and no doubt it has, that a herd has been kept in a very artificial state; hence that stock has become delicate, and purchasers have found it to be the case. Very close in and in breeding will contribute to this imperfection, but these are the results of mistaken management; where different treatment has been adopted, excessive delicacy does not appear to prevail, though it must be admitted they require shelter and warmth; indeed early maturity, and a

great disposition to fatten, cannot be promoted without. The vale districts of South Wales are well suited to Herefords, where, with due care, they thrive as well as in their native county. The Herefords, too, and the same may be said of the Devons, have arrived at their present state of excellence with less of artificial cultivation than the short-horns. One of the constitutional defects in the latter as respects some particular strains of blood, is the proneness to deposit a vast quantity of fat in proportion to the more valuable lean meat or muscle; and in some cases this has amounted to disease. The quality of the food has to a great extent promoted this; the same kind of fat-producing nutriment having been supplied from generation to generation, the defect has become constitutional with some individuals, and they have, in consequence, been rejected as unfit for breeding. To guard against such defects, at the same time to obtain the greatest possible amount of perfections, requires a vast amount of experience, and a very careful investigation of the laws of nature. It is not surprising, therefore, that many who have entered into the speculation of breeding highly-priced pure-bred stock have been unsuccessful in their attempt to produce first-rate animals. Capital is a most essential agent to commence with, but it is useless after all, unless judgment is combined.

The construction of suitable buildings for the shelter and accommodation of cattle is a subject that has engrossed a vast amount of attention. Equanimity of temperature in a climate so varied as that of Great Britain is an acquirement that cannot be attained; but the nearer the approach to it, the more regularly progressive will be the growth and development of the stock. Exposed to the elements—to the keen, piercing blasts of winter, a calf or a yearling in fair condition at the end of October, or the commencement of November, will not be found to have gained size or increased in weight by the following month of April, although supplied with a fair allowance of food, so great is the expenditure of carbon to sustain animal heat, that very little remains to replenish the system. With adequate shelter, and a due proportion of warmth, the same quantity of food will produce very different results. One of the first and most important considerations in the management of cattle, is to keep them in a state of progression from the time of birth; every step of retrogression is a loss of time and food, and a normal condition produces no profit.

Modern improvements in agricultural economy have suggested "Covered Homesteads" for the protection of cattle. They possess many very great advantages, it must be admitted; but on the other hand,

they are probably more than counterbalanced by objections, the most prominent of which is the effect on the inmates. One of the essential features of covered homesteads, is that of manufacturing the manure under shelter; a practice highly conducive to the power and virtue of the manure, but detrimental to the health of the stock.

It is well known that when manure is allowed to accumulate in a mass, it becomes heated, and forms ammonia, thereby promoting disease. Covered homesteads require great attention to ventilation, and, however well the facilities may be designed, they must be constantly watched and regulated. Currents of air produce catarrhal disorders, and manure in a state of fermentation is productive of pleura-pneumonia. As a preventive of the process of fermentation, it is recommended to supply the stock with a very small portion of straw, as litter; but I regard a clean, dry bed as essential to the comfort and economy of the animal. The temperature of a covered homestead can be, with great attention, regulated more equally than that of an open yard, and that may be enumerated as one of the greatest advantages. Open yards, surrounded with ample sheds, are, in my opinion, preferable for the accommodation of breeding stock, dairy cows, and young stock in a growing condition. For the final process of feeding, byres or boxes are the most suitable, as

during that period they require more warmth. I do not believe that the latter can be kept to the best advantage in open yards during the winter months.

As it has been very satisfactorily proved by experiments made by direction of Lord Kinnaird, an account of which was published in the "Journal of the Royal Agricultural Society of England," that manure made under shelter is very superior in value to that which is exposed to the elements, a remedy may readily be adopted, by constructing a covered shed for the express purpose, in close proximity to the homestead, so that the manure can be conveyed away from the yard at stated intervals once or twice a week. The expense attendant upon the construction of such an accommodation would be trifling in comparison to the advantages gained by the increased value of the manure. According to Lord Kinnaird's experiment, more than four tons per acre of potatoes were grown with the manure made under cover than what were grown from manure made in the open yard; and the following year, with the assistance of three cwt. of guano to both plots of land, an excess of fourteen bushels of wheat per acre was produced. If an excess of seven bushels of wheat per acre on only ten acres of land were produced, it would much more than repay the expense of constructing such an edifice the first year. The practice of leaving the manure to accumulate

under the animals in any confined building, must, in my opinion, be wrong.

The plan of covered homesteads implies an arrangement by which all the stock is sheltered under one roof, different compartments being formed with posts and rails, or some similar contrivances, to divide animals of different ages, or requiring different treatment. The economy of labour is greatly promoted by this means.

The quantity of stock kept naturally suggests the dimensions of the homestead, and, where limited, a covered one, providing the ventilation is very amply provided for, is suitable to the amateur farmer; but where there is a very great number of animals collected together under one roof, the atmosphere can scarcely be so pure, however well it may be ventilated, as it is in a less confined situation. If any infectious disorder should manifest itself, the consequences would be fearful. Open yards, if surrounded with spacious sheds, are equal in most respects to covered homestalls, and are more conducive to the healthy condition of the store stock.

On arable farms the system of keeping the stock constantly in the homestead is attended with many advantages,—not an insignificant one being that of manufacturing a very great quantity of manure. Although it is admitted that the urine and droppings

from cattle when depastured in the field will afford a certain amount of fertility, it is very trifling compared with what the same quantity of stock will produce if kept in the yards. As it is decided that the rain washes away a great portion of the fertilizing properties from the dungheap, if it be exposed to an excess, and that the sun and air carry off other valuable constituents, how much more extensively must the same causes affect the manure which the animals deposit in the fields? Opponents to progress and improvement contend that the expense is greater in keeping stock in the yards, carting the food to them, recarting the manure back to the fields, attendants, and other items. On the credit side is to be placed the very great economy of food, not only with reference to the quantity saved, but from the fact that the stock will thrive better with less food when comfortably housed than when they are exposed to the chilling blasts of winter or the scorching heat of summer. There are exceptional cases, where this system cannot be carried out advantageously, in consequence of the inconvenient position of the homestead; but wherever circumstances will permit, it is a plan to be strongly recommended.

The value of the manure, providing equal care be taken to preserve its good qualities, will be found to depend chiefly upon the quality of the food with which

the cattle are supplied. Thus, if grain be given to the cattle, the manure will be more powerful than if they be fed with nothing but straw and turnips. Some of our most experienced agricultural chemists maintain that if you feed cattle only upon straw, the power of the manure will only be equivalent to straw; others oppose to this an argument that animals add to the straw certain secretions which are of some value; more than this, that the undigested fibre and the urine as excretions, combined with the straw used for litter, ferment, and produce from the elements of which they are composed, the essentials necessary to promote vegetation.

Physiologists inform us that the food which animals consume is rendered soluble by the oxygen contained in the air which they inhale, and the fluid which is secreted in the stomach, called gastric juice. The quantity of oxygen inspired is affected by the atmosphere, which contains more in winter than in summer. Air is expanded by heat and contracted by cold, therefore the amount of oxygen is not at all times equal. This affords a reason for keeping animals in sheltered situations of moderate temperature, as relates to the economy of food; there is also another cause, the great exhaustion of adipose and muscular deposit that takes place when they are exposed to the wet and colds winds of the winter season.

The selection of proper food is a subject of very great importance, and has led to the introduction of many different substances and admixtures, some of which are incongruous, others suitable for special purposes, though not for general adoption. A judicious distinction is necessary to produce profitable results. The growing young animal requires nutriment calculated to increase his frame, and although it is essential that it should contain certain portions of all those elements which are requisite to supply the formations of bone, flesh, and fat, it must not be given in too concentrated a form. Saccharine matter and albumen are especially adapted to young cattle, therefore linseed gruel, and molasses in moderate quantities, are found to produce the best effects combined with hay or straw, and roots or grasses. When these mixtures are given, hay is generally dispensed with, or only given as a change, and then in moderation, according to the constitution of the animals. When there is a constitutional disposition to deposit a superabundance of fat—fat-producing nutriment should be withheld, and food abounding more with nitrogenous elements, or flesh-forming materials, such as barley-meal, substituted. If this were more generally attended to, complaints would not be so frequently expressed that the highest classes of animals are, from their phlethoric state, not calculated for

breeding. The custom of giving them oil-cake at a very early age, is often productive of fat amounting to disease. Barley-meal, being essentially a flesh-forming food, has not this prejudicial effect.

It will thus be understood that the food should be adapted to the age of the animal, and also to the purpose for which it is intended, the constitution likewise being taken into consideration. If there be a constitutional tendency to deposit a superabundance of fat, and the animal is destined for the reproduction of its species, the food with which it is supplied should be varied accordingly. Providing the constitutional propensity is the reverse, fat-producing food will be required; and here, again, another distinction should be made, whether the produce is intended for feeding, or for the dairy. Full-grown animals intended for the shambles demand an ample supply of fat and flesh-forming materials, special regard still being held for the constitution.

It has already been shown by the example on Lord Blantyre's farm (at page 53, Manures), the difference in the quality of turnips grown from farm-yard manure and guano, and the same principle will take effect in all cases of a like nature. The quality of the food, in other words the nutritive properties that it contains, varies in different climates, and although supplied in an artificial manner, that is in

the yards or cattle sheds, the effect will not be changed. Variations may, indeed, be recognized on adjacent farms.

Food requires to be supplied in due proportion according to the nutrition it contains. An inordinate quantity of oil-cake or meal, given to a fatting beast, cannot be digested; and by the dictates of nature, the animals speak in the most intelligent language by repudiating their allowance. Time must be allowed for the ingredients contained in the food to be digested and converted into blood, and for that blood to give forth the deposits of flesh and fat. If any part of the system be overloaded, a disarrangement of the functions takes place, and instead of making progress, the animal loses flesh and condition. An excess of watery, or succulent food, as young grass and roots, will disorder the natural functions, and not unfrequently lead to dangerous results. Many persons entertain an impression that the young green herbage of spring is conducive to the healthy condition of horses and cattle; nothing can be more fallacious. Those who advocate this theory, urge that it is an ordination of nature, but a few words will confute that argument. An animal living in a state of nature, sustains the change of food so gradually that it does not take the same effect. This may be observed with stock accustomed to little else

than the bare pasturage they find in the fields during the winter, for on them the young grass as it springs will have no ill effect unless given to them in excess. When the *modus operandi* of that description of food is explained, the supposition of its being calculated to produce beneficial results, must vanish. The young green herbage is extensively charged with sap and moisture of a crude, acrimonious nature, and it exists so abundantly that it cannot be passed off by urine, or taken up by the system. If the animal extensively overgorges itself, hoove, or distension of the stomach from gas takes place, a disorder not unaccompanied with danger; but, if it does not go on to this, a great quantity of the superfluous acrimonious fluid passes on to the intestines, and mixing with the indigestible particles of food, is then discharged in a watery state. It may be accepted as a general principle, that either superpurgation, or continuous purgation will reduce the system, and consequently retard the progress of an animal, in which early maturity is a great desideratum. Many confirmed diseases, which frequently run on to an incurable state, may be averted by attention to the quality of the food; and the effects which it is producing may be readily known by the condition of the alvine discharge.

The advantages gained by steaming, or cooking the

food for cattle have been variously estimated. It may be pronounced a question not thoroughly defined. If I were to hazard an opinion, it is that it depends entirely upon the nature of the food, and consequently of the change it undergoes by the process. To submit all to the process of steam, must in my opinion be erroneous. Linseed and farinaceous food, such as ground oats and beans, undergo a decided change by boiling; a mucilage is formed, which previously exists only in an elementary state, and this is not produced in the stomach during the process of digestion. Barley meal should never be boiled, because that process throws off, in the form of gas or vapour, a great portion of the saccharine matter. The same may be said of straw; and the test frequently expressed by those who adopt the plan, that it emits a perfume similar to that which is produced at a brewery, is evidence that a quantity of nutritive matter escapes. When linseed is boiled, I cannot comprehend that any advantage can be derived from having it previously ground. In performing this operation with the seed unground, the water should be made to boil before the linseed is put in; it should then be kept at the boiling point, and stirred from thirty to forty minutes, when it should be taken out and immediately mixed with straw chaff, as a vehicle for its consumption. I have been thus minute, hav-

ing seen it often spoilt by burning when put into cold water. Bean flour, boiled with water, forms an excellent gruel; and to increase the flow of milk in either mares, cows, or pigs, it is one of the most effective preparations that can be made use of. Some persons may dissent from this, upon the principle that beans are of a heating nature, and that they would have a contrary effect. In their natural state this argument would apply, but when ground, and made into gruel, these properties are changed, and I can confidently recommend this preparation, from experience of its good effects. The steaming of turnips is a process attended with more trouble and expense than the advantage compensates. Some method of reducing roots is nevertheless necessary, to prevent the danger from choking which invariably attends the now obsolete practice of giving them whole. The loss and trouble sustained in olden times, before machines were constructed for slicing and pulping roots, cannot be imagined by the juvenile farmers of modern days. With the exception that it averts the danger from choking, there is, perhaps, no great balance in favour of giving roots sliced or crushed, and the danger from choking is a very serious consideration. The process of mastication is sometimes urged in favour of the turnip in its natural state; but when it is remembered that cattle are ruminating animals,

that argument loses much of its importance. The pulping machines are valuable implements, as they admit of an admixture of straw chaff, which in that state, with the addition of a little meal or linseed, is a good substitute for hay, and less expensive.

It is frequently declared that no profit arises from stall feeding during the winter, and many assert that they sustain a loss thereby; but that the manure made by the process is the inducement. This is a statement that I am not prepared to endorse, providing the proper selection of stock be selected for the purpose. It should not be oxen of any kind. Barren heifers, and cows not too far advanced in the horn, of the Hereford breed, may be bought in October on an average of nine or ten pounds each, which, by the middle of April, say twenty-five weeks, will make from nine to ten score per quarter, which, reckoning beef at sixpence per pound, will sell for eighteen or twenty pounds each. Keeping on turnips or other roots, cut straw and linseed, with a little whole straw at night till Christmas, and the addition of meal the remainder of the time, may be estimated at 5s. 6d. per week, and thus from two to three pounds per head will be realised. This cannot be accomplished unless they be tied up or kept in boxes; neither will oxen improve at the same rate. Another thing, a considerable quantity of meal or linseed cake is fre-

quently given from the commencement, which increases the expense without producing an equivalent improvement of the beasts. It must be admitted that the quality of the manure is better when there is a greater proportion of meal or cake used; but whether that is in equal ratio with the expense, I think is questionable.

The custom of storing turnips, extensively adopted of late years, cannot be too strongly recommended. On no account ought any stock to be fed with them in a frozen state, and a glance at olden custom will most satisfactorily clear up this point, if any doubt exists. The cattle were turned into the turnip field, let the weather be what it might during the day, a portion of the turnips being hurdled off. One of the objects was that of manuring the land; but when wet, the injury occasioned by poaching, as it is termed, was immeasurably greater than any advantage that could be derived from the manuring process. The cattle were brought to the yard at night, and there supplied with straw; thus they had their fill of watery turnips during the day, and of dry straw at night. As a modification of this plan, the cattle were sometimes put upon a piece of old turf to eat the turnips, but still the opportunity of making a large bulk of good manure was lost. Keeping them in the yards night and day, and supplying them with pulped roots

mixed with cut straw and meal, according to circumstances, is a vast improvement. At the same time the propriety of giving them an allowance of uncut straw should not be neglected. It excites the process of mastication, which is a natural function of the animal. If the old custom of consuming the turnips in the field on very dry soils had not the effect of materially injuring the land on wet soils, it was very prejudicial.

Considering the cost of growing a good crop of turnips, it is surely bad economy not to secure them in the best possible condition. In frosty weather the loss sustained by turnips is incalculable. In a frozen state, as it has been already observed, roots are improper as food for stock of any kind. After either turnips or mangel wurtzel have once been frozen, if they do not become rotten, they never recover their pristine virtues, which is readily discovered by cutting one across that has been exposed to the changes of temperature, and comparing it with one that has been carefully stored. To have them in perfection they should be taken up during a dry time, and as soon as they have attained their full size; leaving them in the ground after that impoverishes the land, and the quality of the root deteriorates; at the same time they should be allowed to become quite ripe, or loss will be sustained from that cause.

The numerous advantages presented to agriculturists and the country, through the agency of Agricultural Societies, cannot be overrated. With the exhibitions of the Smithfield Cattle Club, and those of the Royal Agricultural Society of England to take the lead, seconded by local associations in almost every county or district, a spirit of rivalry and emulation has been engendered, which has led to the most gratifying results. By this means it is determined which are the best animals of their respective classes, although something more is wanting to decide which are the best breeds for special purposes. The increased value of prize beasts and the stock to which they are kindred, has operated as an additional stimulus to exertion and enterprize. It has not been confined to these sources alone that farmers have been gainers by agricultural societies. The very great progress made in the improvement of agricultural implements, has been to a vast extent promoted by the awards for inventions calculated to supersede the tedious process of manual labour, which in many cases is unequal to the task, and yet that which is beyond the scope of the labourer is readily accomplished by machinery. We are now on the eve of a new era in agrarian progression, the application of steam for the tillage of the soil. Then, again, agricultural meetings are pregnant with information.

They promote social intercourse between practical men, not only of the united kingdom, but from foreign climes, and very few indeed depart from one of these gatherings without having learnt something to their advantage.

The ultimate perfection of fat stock, however, cannot be thoroughly decided at these exhibitions. The homely adage, that "the proof of the pudding is in the eating," may be well applied. It is when the ox is slaughtered, and hanging in the butcher's shop, where the true quality of the richest, the choicest, and thickest meat, laid on most evenly with a true distribution of fat and lean, can be determined. Then come the mysteries of the *chef de cuisine*, and a good appetite to decide upon the flavour. In the shambles, the Herefords and Devons bear the palm of the other breeds, the Welsh and Scots excepted. Now in this there is something approaching to anomaly. Wherever prizes have been offered for the best animals of any breed, none but short-horns, Herefords, and Devons have been the successful candidates, although for dead meat they have superiors in the Welsh and Scots. The best meat cannot be distinguished in the living animals, when they so nearly approach perfection.

SHEEP.

In the early pages of Divine History we read of sheep in the category of domestic animals, or private property, and a man's wealth was computed by the numbers of his flocks and herds. Probably it was not till the invasion of the Romans that sheep were much known in England. At that time they were esteemed principally for their wool, and it was not till a much more recent period that their true value as food was duly regarded.

It requires no useless research, or waste of time and labour, to trace the character of this animal to an early date: we have sufficient evidence in the mountain sheep of the present day, in contrast with the portly Lincoln, or stately Cotswold, to show the vast improvements that have been made in the species both as respects the superior quality of flesh and fleece. No class of animals is more susceptible to the changes of food and climate; a fact known to the ancients, and daily experience confirms this truth.

The extraordinary effects produced in sheep by food, climate, and treatment may be readily determined by comparisons, of which there are constant opportunities. Having in byegone days paid frequent and lengthened visits to a departed friend, who resided in a mountainous district in Carmarthenshire, I can speak from personal experience on the peculiarities and conditions of the sheep in that and the adjoining county of Cardigan. A more primitive state can scarcely be conceived. I am referring to a period from 1828 to 1843, and I have reason to believe the management of sheep has not undergone much, if any, improvement in those parts since that time. With but very few exceptions, and those on the estates of gentlemen who cultivated a portion of their property, scarcely a turnip was grown for winter keep in that part of the country. During the summer months the sheep were depastured on the mountains, where they subsisted on moderate fare, as the herbage is naturally coarse and of indifferent quality. In the winter they were nearly starved, and many perished during the inclement season. If their owners possessed it, they would give them an allowance of bad hay or straw. So kept, it will occasion no surprise, when it is mentioned that the sheep were very small, not weighing, when in their best condition at three years' old, more than twelve or thirteen pounds per quarter.

They were high on the legs, with long tails, and as wild as the mountains on which they were bred. They would fly on the appearance of a dog; and, if pursued, with the fleetness and activity of deer, clearing the fences with extraordinary ease. From this brief sketch it will be thoroughly understood that until turnips were cultivated, and other succedaneums employed for feeding sheep even in the genial pastures of England, how little the general improvements could have been made in the breeds of sheep, unless expenses had been incurred which would have been incompatible with profit.

Symmetry is inseparable from the highest degree of perfection in all domestic animals, whether destined for feeding or for labour. Animal organism in the highest state to which it is capable of being brought is thus associated. The eye of a practised connoisseur becomes acquainted with true contour, adequate proportions, and beauty of form, by which he is enabled to arrive at a just estimate of the qualities animals may be expected to display for specific purposes. Mr. Bakewell, whose name has been previously mentioned as a distinguished breeder of cattle, must have been wonderfully gifted for discrimination, regarding the true form of cattle and sheep, and with him it must have been an almost original talent. He afforded an excellent example, by his practice,

after which many others were happy to acknowledge his principles; and highly as he was respected for improving the breed of long-horned cattle, he was equally, if not more, successful with sheep. The Dishley or New Leicesters, as they were at that time styled, had, so to speak, their origin from Mr. Bakewell. The long-horned breed of cattle has gone out of fashion, but the Leicester sheep are still in vogue. The spirit of enterprize was great at the time, and soon after Mr. Bakewell's career; as it is related, that a party of eight Lincolnshire breeders, Messrs. W. Thorpe, Loft, J. Loft, Astey, Rogerson, Slater, and Cook, at the commencement of the present century, hired a Leicestershire ram from Mr. Buckley, for one season, at the enormous price of one thousand guineas.

Of the precise form of the sheep from which Mr. Bakewell established his flock there is no exact data, but the perfection to which he brought them may be judged from the description given of them by the no less celebrated Mr. Culley. It is a good precept at the present date, and applicable to all modern breeds of sheep, Downs excepted, which are valued for a less proportionate weight of the fore-quarters, being less profitable than legs and loins as butchers' meat; the wool of the latter is also finer and more compact in texture. Mr. Culley says, "The head should be

hornless, long, small, tapering towards the muzzle, and projecting horizontally forward; the eyes prominent, but with quiet expression; the ears thin, rather long, and directed forwards; the neck full and broad at its base, but gradually tapering towards the head, and particularly fine at the junction of the head and neck—the neck seeming to project straight from the cheek, so that there is, with the slightest possible deviation, a continued horizontal line from the rump to the poll; the breast broad and full; the shoulders also broad and round, and no uneven formation where the shoulder joins either the neck or the back, particularly no rising of the withers, or hollow behind the situation of those bones; the arm fleshy through the whole extent, and even down to the knee; the bones of the leg small, standing wide apart, no looseness of the skin about them, and comparatively bare of wool; the chest and barrel are at once deep and round in the ribs, forming a considerable arch from the spine, so as in some cases, and especially when the animal is in good condition, to make the apparent width of the chest seem greater than the depth; the barrel ribbed well home; no irregularities of line on the back or the belly, but on the sides of the carcass very gradually diminishing in width towards the rump; the quarters long and full, and as wide as the fore legs; the muscles extending down to the hock; the thighs also

wide and full; the legs of a moderate length; the pelt also moderately thin, but soft and elastic, and covered with a good quantity of white wool, not so long as in some breeds, but considerably finer."

The adjoining county of Lincoln has long been famed for sheep of great size, and for quantity of wool they are unrivalled. The climate and nature of the soil in that fine county are admirably adapted to force animals to the highest standard; and they are very extensively spread over it. They have great merit to recommend them, but the breed is principally confined to the county and the most fertile parts adjacent. They are not, in all probability, suitable for less forcing pastures. An occasional cross of the Leicester keeps up the true form, and the propensity to feed at an early age.

Amongst the heavy breeds there are certainly none equal to the Cotswolds; they are of enormous size, very hardy, arrive early at maturity, and clip a great quantity of wool. Their form is much in accordance with Mr. Culley's description of the Bakewell breed, but of gigantic proportions. There is a character of stately grandeur about their appearance which distinguishes them from all other breeds. Their native district may be said to extend nearly from Bath, through a great portion of Gloucestershire

by way of Northleach, to Stow-in-the-Wold, and thence to the neighbourhood of Witney, in Oxfordshire. A great portion of this extensive tract is hilly and bleak; but, with the exception of some of the undrained land in the vales, it is sound and healthy, and decidedly better adapted to this breed of sheep than any other hitherto introduced. The breed has been greatly improved within the last five and twenty years. They were formerly coarse in the bones, and heavy about their heads, in proportion to their bulk, but these defects are now corrected to as great an extent as their size will permit. Most of the celebrated breeders reside at no great distance from Northleach, and they include Lord de Manley, Messrs. Beale Browne, George Fletcher, Edward Handy, William and George Hewer, John and William Garne, Thomas Wells, William Cother, and many others.

The truly grand-looking Cotswold ram bred and exhibited by Mr. George Fletcher, at the meeting of the Royal Agricultural Society of England, held at Lincoln in 1854, will not readily be forgotten by those who saw him. A finer model of a large framed lengthy sheep could not well be conceived, and it adds not a little to the fame of the Cotswold breed, that in all the classes in which they were qualified to compete with the Lincolns, as long-woolled sheep,

they wrested the laurels from the latter in their native county.

The South Downs essentially claim the county of Sussex as their home; but the very great perfection to which this breed has been brought, and the very excellent qualities which were, no doubt, extensively different among the originals, long before the cultivation of the race was undertaken, have caused the breed to be spread far and near. There is scarcely a county or district in England and Wales in which some of the true sort may not be found, and traces of the family may very frequently be distinguished in crosses of the common breeds. Their native downs are most peculiarly adapted for the production of mutton of exquisite flavour. Clothed with short fine herbage of remarkable sweetness, on a dry soil, and surrounded with an atmosphere temperate but bracing, every good property is provided by nature during the summer seasons to supply sheep with the choicest food, and the arable land, generally on a chalky subsoil, is well adapted for the growth of turnips. On most dry soils the South Downs maintain their high character; and although, in some cases, slight changes may take place, the most celebrated Sussex breeders are often glad to avail themselves of crosses from the pure-bred flocks of distant cotemporaries. In France and America too they are highly prized, and there

are no sales or lettings of rams of eminence that are not attended by foreign breeders. The late Mr. Ellman, of Glynde, near Lewes, was one of the first to improve the original breed. That excellent patron of agriculture, the Duke of Richmond, has also been instrumental in bringing them to their present state of high perfection. His Grace's sheep have for many years shone brilliantly at the exhibitions, at which they have gained many prizes; and although on some occasions there may have been others, the choicest of their respective flocks, to which the judges have made their awards, yet taken as a flock, I am inclined to the opinion that none excel, if any equal, the noble Duke's. There is an aristocracy of appearance that bespeaks their pure lineage; and when they are inspected on the splendid range of downs at Goodwood, which form a distinguishing feature of the ducal domain, there is a harmony of character, so to speak, between the sheep and the scenery probably not equalled in any other part of England.

The Earl of Chichester and Sir John V. Shelley have been great patrons of the breed, and the name of Ellman is still prominent on the Sussex downs, together with Messrs. Rigden, Haywards, Boys, and others of much celebrity.

Lord Walsingham in Norfolk, Colonel Kingscote in

Gloucestershire, Mr. Jonas Webb in Cambridgeshire, Mr. Lugar in Suffolk, and Mr. Sainsbury in Wiltshire, have each of them contributed to establish the fame of these sheep in different counties, and have proved incontestably how well they are adapted to the respective soils and climates of the districts in which they are bred.

Nearly approximating to the South Downs are the Hampshire Downs, a larger kind of sheep, of great merit. There are advocates for all the superior breeds of sheep, and their advocacy may be supposed to arise from the experience they have gained by choosing those breeds which they have found to be best adapted to their farms. Thus some breeders prefer the Hampshire to the South Downs, urging that they are more hardy, and come to greater weight; at the same time producing meat and wool of equally good quality. On these points, however, I am inclined to entertain some doubts.

A breed has of late years come into great, and very just, repute, called the Shropshire Downs. They possess the good points of the South Downs in outline, with considerably more wool and size, and the wool is more valuable in the market, being longer in the staple, with more lustre than the wool of any other downs, still firm and thick, and of a nature to resist wet; a most important feature in exposed situations,

and a manifest superiority over the soft open wool of the Leicesters. They are black-faced, like the South Downs.

The Shropshire Downs are very hardy, and do well on poor lands in elevated situations; they are adapted to hilly districts, being active, and will bear to be kept very thick on the ground. A very celebrated breeder of these sheep, near Leintwardine, lambs 350 ewes on 530 acres of land, besides keeping a large stock of cattle. This breed appears to have been produced by crossing the Southdown ram with the ewes of Clun forest, a bleak district between Bishop's Castle, in Shropshire, and Knighton, in Radnorshire. In that immediate neighbourhood, and in Corve dale, they have been acknowledged as a distinct breed for the last fifty years, though the public will not admit them as such. They are very different, and far superior to the cross breeds with grey or black faces produced by an intermixture with Cotswolds and Downs, or Leicesters or Lincolns with Downs. Their hardihood is a very great recommendation to them in cold climates, and it is very certain they own a near kindred with the South Downs.

The question, What ought to constitute a title to purity of blood? has been already mooted with respect to cattle; and this affords another opportunity to re-

sume the subject concerning sheep. If a particular breed be established in any country or district possessing excellencies, for certain purposes, in a greater degree than other breeds, is at the same time exempt from objectionable defects, and has passed through as many generations as may be fairly considered sufficient to entitle it to the distinction, it is but justice to the enterprise of those breeders who to so great an extent make advances in a most important branch of agriculture, to reward their exertions and encourage others, by placing their stock in a similar position with those breeds which are already so distinguished, yet after all with no better title. The long-woolled breeds which are admitted as pure, have all of them crosses, more or less distant, with the Leicesters. The Shropshire Downs have been brought to great perfection by the Earl of Aylesford, Messrs. J. B. Green, W. Foster, Henry Smith, and James Hand. The great object has been to enlarge the frames of the South Downs, and retain all their other good qualities; and this has been accomplished by "the proud Salopians" most successfully.

There are other breeds of sheep which claim distinction only in connection with localities, and among these may be mentioned the Cheviots and the black-faced mountaineers of the Scottish border; the breeders of which appear not to covet any admixture

with larger sheep. In this they are most probably correct, for it is very evident that size is incompatible with the hard fare inseparable with mountain pastures, and to adopt an extensive system of artificial treatment would be quite at variance with the sheep-farming of those districts.

There is no animal on which the effects of climate and pasturage have so great an influence as the sheep. This may be regulated to a trifling extent by treatment and artificial management; but in the general arrangement of sheep-farming, nothing is of greater importance than the selection of a breed the best adapted to the locality. This will vary sometimes on contiguous farms. I have seen instances of South Downs, bred from the flocks of the most eminent breeders, which, in the course of two or three generations, have degenerated astonishingly by being reared on strong, luxuriant soils, which are better adapted for those of greater weight. The effect has been very distinctly marked in the third generation, both with regard to symmetry and the quality of the wool.

In order to adapt them to locality, many crosses have been resorted to, such as Leicesters with Cotswolds, Downs with Cotswolds, and Downs with Leicesters. Whatever the cross may be, it is very important not to run into great excesses by crossing

animals widely differing in their properties and proportions. On this account it is extremely injudicious to put a large ram to an undersized ewe, as increasing the danger of parturition, especially if the ram has a coarse head. A large-boned sheep, too, is an inconsistent cross for one of more delicate frame, as also the extremes of long and short wools. Another very important consideration is the purity of breed on the part of the male, a circumstance which should never be lost sight of in the breeding of any animals. In very many instances the first cross has proved to be superior to future ones, and that principally from this cause, that the ewes of the first cross have not been put to rams of more pure lineage than themselves. It was laid down as a principle by the late Earl Spencer, than whom none have devoted more attention to the mysteries of nature in the reproduction of animals—"That when a pure animal of any breed has once been pregnant to one of a different breed, she is herself a cross ever after." This subject has been more discursively treated in the work by Youatt, "On the Horse," revised in 1855, and published by Messrs. Routledge. It will be found at page 111.

It very frequently happens that flocks peculiar to districts, or perhaps to some particular farm, although greatly intermixed, yet possessing many good

qualities, may be wonderfully improved by the introduction of a ram of a pure breed. The success will depend upon the judgment applied in the selection. The first intention will necessarily be to correct the imperfections; with this must be combined the peculiarities of the food and climate, and the adaptation of the cross to those peculiarities. Presuming the flock upon which the improvement is proposed to be engrafted is constitutionally adapted to the situation, and without that the attempt would be futile, the characteristics of the originals will be the safest guide as regards the choice of the kind of rams. To be perfectly explicit, it would be absurd to expect that a Cotswold ram is a desirable cross for the undersized ewes of Wales; they are in danger at lambing time, and they are not able to support their offspring; besides which, the half-bred Cotswold is quite out of his element in the Welsh mountains. This is certainly an extreme case, but excesses as great have been perpetrated, and terminating unsuccessfully, further attempts at improving local breeds have been abandoned. An infusion of the blood of the Shropshire Downs on the mountains of Wales is attended with the most satisfactory results. They originated from stock somewhat similar in character and of similar habits, and with good management, at the same time ex-

tending the cultivation of turnips, this breed, in combination with the common sheep of the country, is raising the breed of sheep in the principality to a standard of importance. The mountain sheep can live and thrive in climates and situations where scarcely any other animals can exist, and they may be made to produce a profit from those otherwise barren tracts, where the bases of the mountains, being under cultivation, may be readily appropriated to the growth of winter food.

There are so many phases in the various departments of agriculture, that it is impossible to lay down systems which shall be universally applicable. But in the management of sheep, shelter is of the very greatest importance during the inclemencies of winter. Mr. Nesbit, in one of his very able lectures on agricultural chemistry, mentions an experiment made by a friend of his, with "two lots of sheep on the same amount of food;" he kept thirty sheep folded in the open air, and they gained on the average one pound a week each. For the other lot, he placed double hurdles, with straw between, against the prevailing wind; the hurdles fastened together with string, and on the top were placed other hurdles covered with straw, forming a lean-to, so that the sheep might go under cover; and these sheep made on an average three pounds of meat each per week on the same amount of food as

was given to the others, which, being exposed, gained only one pound, and all the time they were treading in the straw on which their food was placed.

A spacious and well-constructed yard, with a sufficiency of shed-room, if conveniently situated for the consumption of the root crops, is no doubt by far the best mode of arrangement, but there are few farms provided with such conveniences. In default of this, Mr. Nesbit's plan is an admirable one, as it may be constructed on any convenient spot sufficiently dry for the purpose. It is a great improvement upon the ordinary practice of folding sheep on the turnips, not only with reference to the well-doing of the sheep, but in the economy of labour, and wear and tear of hurdles, which is considerable when they are required to be frequently removed. A similar plan has been for many years adopted by breeders of Cotswold sheep, and also in parts of Buckinghamshire and Warwickshire.

Under any circumstances, wet is exceedingly prejudicial to sheep, whether it proceeds from undrained land or from the atmosphere. It is productive of the rot; and there are many thousand acres of meadow land upon which it is not safe to depasture sheep from that cause; during rainy winters many sheep are affected when eating turnips off land that is not sufficiently dry for the purpose. Wet produces

most injurious effects on the quality of the wool as well as the constitution of the animals.

There are, however, several reasons for affording shelter to sheep. Being ruminating animals, when they have partaken of their quantity of food, they require repose, that they may accumulate flesh as rapidly as possible; for it is during the period when the function of rumination is going on that the process of fattening takes place. Muscular action necessarily produces a waste of the system, and therefore, driving them any distance, or even short distances at brief intervals, is calculated to impede the disposition to fatten, and consequently to lessen the profit; but when there is a constitutional disposition to lay on an excess of fat in proportion to lean meat, the remedy might be found in very moderate action, although it is an alternative that would require the greatest possible caution.

A well-sheltered yard, or temporary fold, affords an asylum for sheep where they can be supplied with food free from the intrusion or annoyance of other animals; and this, in combination with the improvements introduced of late years, presents many advantages; in fact, some accommodation is necessary to give full effect to those improvements. There are advocates for the time-honoured custom of folding the sheep on the land where the turnips are grown, for

the sake of increasing the fertility of the ensuing crop. If the land be of a very light nature, and a moderately dry time can be selected, this may be done without prejudice to the flock, and with some probable benefit to the land. Treading that kind of land will no doubt improve it. But for lands of stronger texture, in a high state of cultivation, and full of manure, it is not necessary to the production of the future crop, especially if it be barley, to eat the turnips off on the land; indeed, in such cases it often proves detrimental to that crop, causing it to be laid flat on the ground; if it be a wet period during harvest, the grain in that state becomes seriously sprouted, and damaged for malting, and the straw becomes very indifferent fodder. The young clovers or seeds are also injured by the lodgment of the barley. This is readily accounted for by the predominance of nitrogen in the dung and urine of the sheep, in proportion to lime or phosphate in the soil, which, according to the very general system of manuring, is a very frequent cause of failure, both in the strength of the straw and luxuriance in the succeeding clover.

The injury sustained by sheep being folded on turnips, even if the land be naturally dry, during wet weather, is far greater than is generally anticipated. The natural condition of these animals adapts them to the turf, and most essentially to hilly, mountainous

tracts. Their feet are formed to give them a firm tread upon the greatest declivities, and their fleeces are better calculated to protect them from cold winds than from the effects of saturation with mud and water. The practice of feeding them with turnips is strictly artificial, and artificial extremes which are opposed to their natures cannot fail to be injurious.

Irrespective of the advantages which the flocks gain from the accommodation of sheltered yards or folds, the quantity of valuable manure they will make is far more than an equivalent to the cost of attendance, providing judicious arrangements are made for this purpose. When fed on the land where the turnips are grown, it must be admitted that a considerable portion of the fertilizing properties of the dung and urine are expended by evaporation, or diluted and washed away by the rain.

The great object to be attained in the management of sheep, intended for feeding, is to keep them in a state of progressive growth from the time of their birth. The improved breeds may be made, by good attention and proper keep, fit for the butcher in twelve, fifteen, or eighteen months; whereas our forefathers were content if they could get them fat in twice that space of time. To do this satisfactorily, experience and forethought are necessary. If they are allowed to go back, as it is termed, till their retrogration is

visible to the eye, great loss will necessarily be sustained. In case sheep lose a fortnight's improvement, it requires the lapse of the succeeding fortnight to recover that loss, and another fortnight must pass away to place them in the condition they would have been, providing progressive advancement had taken place. There are several minor details in the management of sheep which, individually, appear trifling, but collectively they assume some importance. The same treatment will not in all respects suit every breed, neither will it suit all localities. If the utmost success is aspired to, the peculiarities of the sheep must be studied, as well as the appliances of the farm. Some of the highest-bred sheep have an inclination to accumulate a proportion of fat considerably in excess of lean, which may perhaps, to a certain extent, be remedied by the quality of the food with which they are supplied; but any attempt to restrict this by reducing the quantity must result in disappointment, because, in the latter case, the animals would not make a sufficient increase of flesh.

The most certain means of insuring early maturity with a well-chosen breed of sheep, is to supply them with food of a consistency adapted to their age, and by increasing the nutritive proportions from time to time. This cannot be accomplished by giving them scanty supplies during the winter season, and abund-

ance in the summer, though by that means the proportion of muscular development will exceed that of adipose deposit, and the meat might be of better quality; but this is inconsistent with profit. By reversing this order, that is, by keeping them scantily during the summer, and giving them abundance of winter keep, sheep will very commonly accumulate a great amount of fat, putting it on unequally in patches, and there is a greater loss than by the other extreme. Change of food is, however, imperative as experiments afford examples of various animals having been reduced to the lowest extremities of existence, from having been kept for a length of time on one kind of food. The requirements of the animal system demand this, from reasons already explained; but as the progress of the sheep is so materially influenced by frequently changing the dietary, it cannot be too earnestly impressed.

The flavour of mutton depends upon the nature of the food upon which the sheep have been fed. In artificial feeding, by which may be understood feeding with turnips, or mangel wurtzel, meal, linseed, cut straw, and hay, very little appreciable difference will be found between the flavour of the meat of any of the pure breeds, though the texture will vary. The most exquisitely flavoured mutton is that which is fed on the downs of Sussex, where the pasturage abounds with the most delicious herbage.

Hence one reason for the most fastidious consumers of mutton giving a preference to Downs, not taking into consideration that those which are fed on different pastures hardly attain the fine flavour of the originals. Their size, too, is a great consideration with connoisseurs of meat, who do not appreciate gigantic joints.

The implements which have been invented for preparing food for sheep are of great value; their use is daily on the increase, and this must eventually lead to their very general, indeed almost universal introduction; this progression will necessarily be accompanied with the adoption of the improved methods of keeping sheep and other kinds of stock. That there is great economy in slicing or pulping the roots consumed by sheep, there cannot be a doubt, and the combinations of food which are by these means easily available, tend, not only to the early maturity of the flock, but ultimately to the advantage of the farmer.

THE END.

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